ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXVI. No. 47.

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THE GROSS EARNINGS OF 147 RAILWAYS, operating 100,022 miles of road, for the month of October, according to the *Financial Chronicle*, are $58,058,545, as compared with $53,492,548 for the corresponding month of 1890, an increase of 8.54%. This is the largest increase but one (September) of any month of the present year, and the largest for the month of October since 1889. This result is largely due to the heavy grain and cotton movements, other business being on the whole considerably lighter than it was last year. In addition to this large aggregate gain the tables show that the increase has been quite general, only 35 roads of the total number showing decreases. Forty-five road exhibit gains of over $40,000 each, and an aggregate gain of $4,180,385, and three roads exhibit losses of over $40,000 each. The largest increase is shown by the Chicago, Milwaukee and St. Paul, viz., $570,885, and the second in size by the New York Central & Hudson River, $540,235. Considered by groups, the Northwestern, Southwest and Southern groups exhibit the best results, in short, the grain and cotton-carrying lines.

A LOCOMOTIVE SIGNALING DEVICE, designed and patented by Mr. C. T. BARRETT of Brooklyn, N. Y., so arranges a short battery circuit on the locomotive that when the circuit is closed by the engagement of a movable wheel on the track with a projecting arm on the locomotive, an electric bell rings for some seconds in the cab, and at the same time a red or green signal is displayed, as the case may be, the actuating wheel, of course, being connected with the rods or wires which move the signals. The end aimed at is the same as in the devices which cause the locomotive whistle to blow when an inclined rod is placed or raised along the track, but by the use of the battery circuit, it is claimed that the signal is more certain, more easily given, and more effective in showing either green or red.

THE NEWARK, N. J., WATER SUPPLY is nearly ready for delivery. The two storage reservoirs in the Pequannock water shed are completed and are slowly filling up. The intake at Smith's Mills is finished and connection was lately made with the high service reservoir in Newark, 25 miles from the intake, and connection was made with the Belleville reservoir over one month ago. The 4 ft. steel pipe has been carefully tested for 5 miles from the intake and no leaks of any importance found, saving that coming from a loose manhole cover. The official test will not be concluded for the whole line until the full head is available. As before given in detail in this journal the East Jersey Water Co. proposes to give Newark 50,000,000 galls. of water daily for the sum of $6,000,000, but the other towns tributary will have to pay for the water by the gallon. The head at the two storage reservoirs now built is 750 and 800 ft. and 400 ft. at the intake. Other storage reservoirs are contemplated.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision, Nov. 11, at Medina, Tenn., on the Illinois Central R. R. The engine driver and conductor of a freight train which was ahead of its scnedule time tried to reach the station next to the one at which they should have sidetracked for a passenger train, and, as usual, the result was a collision. There were 4 men killed and several injured. A similar accident occurred Nov. 17 on the Grand Rapids & Indiana R. R., near Grand Rapids, Mich.

A NEW TYPE OF STEEL STEAMER is being built by the Union Dry Dock Co., of Buffalo, for the Anchor line of lake steamers. This steamer differs from craft of the old style in having decks perfectly straight fore and aft, with no sheer whatever. Thus far the model somewhat imitates the whalebacks, but otherwise the steamer is like an ordinary lake craft. She will have gangways and hatches suited to carrying all classes of freight. The dimensions of the steamer are 300 ft. over all, 275 ft. keel, 40 ft. beam and 26 ft. hold, with triple expansion engines of 1,200 H. P. and two steel boilers 14½ ft. in diameter by 12 ft. long. The price paid is $178,000. The steamer is to be ready for business by June 1.

THE COOPER, HEWITT & CO.'s IRON WORKS have been sold to an American-English syndicate for $5,000,000. The sale includes the New Jersey Steel & Iron Co., the Trenton Iron Co. and wire mills, at Trenton, N. J., and the Durham Iron Works, mines and furnaces, at Durham, Pa. Senator JOHN P. JONES, of Nevada, is said to be actively interested in the new company to be formed, or The Cooper-Hewitt Co. Among the American directors mentioned are JOHN W. MACKAY, JOHN P. JONES, CHARLES C. DODGE, HORACE K. THURBER, FREDERICK SLADE and WALTER COOK. Among the English directors is Colonel NORTH, the "Nitrate King."

COMPRESSED AIR FOR CLEANING CARS is used on the Union Pacific Railway at its Portland shops. The air under a pressure of 50 lbs. per sq. in. is delivered from a flexible hose with a small nozzle, and is used as water would be. The results achieved are said to be very satisfactory, especially in cleaning the plush seat cushions.

THE FIRST VESTIBULE TRAIN EVER RUN, according to an article in the *Railroad Car Journal*, was on the Naugatuck R.R. in 1853. Cuts of the device as applied are given, bearing a close resemblance to the modern vestibule plant, and also a letter from the then superintendent, dated May 6, 1854, thoroughly endorsing the vestibuled cars "then in use" as entirely successful. The rock on which the experiment seems to have split was bad ventilation, a rock which the vestibuled trains of to-day often graze.

THE NEW YORK RAILROAD CLUB elected the following officers at the annual meeting on Nov. 19: President, R. C. BLACKALL; Vice-Presidents, G. W. WEST, W. L. HOFFECKER, THOS. ALDCORN; Secretary, H. G. PROUT; Treasurer, C. A. SMITH; Executive Committee, JNO. S. LENTZ, W. H. LEWIS, W. W. SNOW, W. J. WATSON, W. C. ENNIS; Finance Committee, E. H. ANDRESS, J. H. BAILEY, S. W. McMUNN.

THREE MORE ARMOR PLATES were tested at the Indian Head proving grounds on Saturday, Nov. 14. Plate No. 1 was a high carbon nickel steel, made by Carnegie, Phipps & Co; No. 2 was a low carbon nickel steel plate, treated by the Harvey process, and rolled by the same manufacturers; No. 3 was a high carbon nickel steel plate treated by the Harvey process and rolled by the Bethlehem Iron Co. At each plate five shots were fired, four from a 6-in. gun, followed by one from an 8 in. gun at the center of the plate. The position of the shots, and the guns, projectiles, powder charges, initial velocity and target distance were the same as in the tests on Oct. 31, reported in our issue of Nov. 7.

THE RESULTS OF THE TEST were briefly as follows: *The high carbon nickel steel plate* from Carnegie, Phipps & Co., received the four 6-in. shots with an average penetration of 11⅞ ins. The first two shots caused no cracks. Three small cracks radiated from the third shot hole, one appearing just after the shot and the other after the fourth shot. The projectiles rebounded in every case, the first three breaking up and scattering. The 8-in. projectile penetrated 9¾ ins. and rebounded whole but scaled and cracked. This caused a ½-in. crack diagonally across the plate in addition to those made by the 6-in. shots.

The low carbon nickel steel plate from Carnegie, Phipps & Co., treated by the Harvey process, received the four 6 in. shots with an average penetration of 12⅛ ins. None of these shots caused cracks. Three of the projectiles stuck in the plate intact, neatly plugging the holes, while shot No. 3 penetrated only 9¾ ins. and rebounded whole a distance of 47 ft. The 8 in. projectile penetrated 15¾ ins. and rebounded broken up. This caused one crack ¼ in. wide and another ⅛ in. wide from the upper and lower shot holes to the edge of the plate.

The high carbon nickel steel plate rolled by the Bethlehem Iron Co. and treated by the Harvey process received the 6-in. projectiles with an average penetration of 8⅛ ins., the smallest shown by any of the six plates thus far tested. Two projectiles rebounded, one whole and one broken up. The other two, which penetrated the plate only 5 ins. and 5⅛ ins., respectively, had their points welded in the plate, while the bases broke up and scattered. The third shot, which penetrated 12¼ ins., caused 8 small radial cracks. No cracks resulted from the other three shots. The 8-in. shot penetrated 12⅝ ins. and rebounded whole. This started diagonal cracks ¼-in. wide from the center shot hole through the upper and lower left hand shot holes to the edge of the plate. These cracks are ascribed to uneven tempering of the plate. Even with them, however, this plate is considered by Commodore Folger to have made the best record of any of the six plates tested.

THE VALUE OF NICKEL in increasing the toughness of armor plate, preventing cracking and decreasing penetration, seems abundantly proved by this series of tests. It is now definitely decided, therefore, that the armor for our new navy will be of nickel steel. Whether the Harvey process will be adopted is still undecided; but its value seems pretty well attested by the behavior of the plates treated by it. A point of exceeding interest is the high standard which American makers of armor plate have attained at the very start, the plates tested at Indian Head having surpassed the record made by the best specimens of plates of foreign manufacture tested at the Annapolis grounds last September.

We shall next week give a full description of these tests, which may justly be considered the most important armor plate tests yet made, with engravings of the plates as they appeared after the firing.

A BRIDGE ACROSS THE BOSPHORUS is again proposed, this time by Messrs. GIANO and GOURRIER. It would cross from Stamboul to Scutari, with a total length of 6,500 ft., or 4,920 ft. between shore abutments. The clear height under the six spans proposed would be 131 ft. The maximum depth of water is 105 ft. The design given in *Le Genie Civil* shows cantilever spans with a horizontal base and arched top chord, without any suspended spans.

THE ZONE SYSTEM OF TARIFF is being discussed by railway lines centering in Chicago for adoption during the World's Fair. The plan is to make Chicago the center of six concentric circles, the first with a radius of 50 miles, the second 100, then by the hundreds to the sixth, which includes the entire country beyond 400 miles. A man living less than 50 miles from the center would receive a reduction from present passenger charges of 10%, the reductions to increase from zone to zone up to 50%.

The New Freight and Weehawk n Ferry Terminal for the West Shore R. R. at the foot of Franklin St., New York City.

Through the courtesy of WALTER KATTE, Chief Engineer of the New York Central & Hudson River and West Shore R. Rs., we are enabled to present the general plans for the new freight and passenger ferry terminal to be built at the foot of Franklin St., New York City, for the West Shore R. R. In the memorable battle for traffic which followed the opening of that ill-starred road, the lack of convenient terminal facilities on Manhattan Island was one of the heaviest of the obstacles which handicapped it in obtaining traffic. Ever since the opening of the road, its traffic to and from the lower end of New York City has been handled under many disadvantages. The buildings at the foot of Jay St. which were originally put up for the company, and were intended for temporary use only, were one story wooden sheds; but they have answered the purpose for which they were erected ever since.

The new terminal is to be located one block farther uptown, a somewhat better situation on account of proximity to shipping centers, etc. An advantage was also gained in having a site wholly independent of the existing terminal, there being neither delay to the traffic nor to the progress of construction, and no increase in cost of the latter, one or all of which are apt to be found when it is attempted to rebuild a terminal already accomodating a busy traffic.

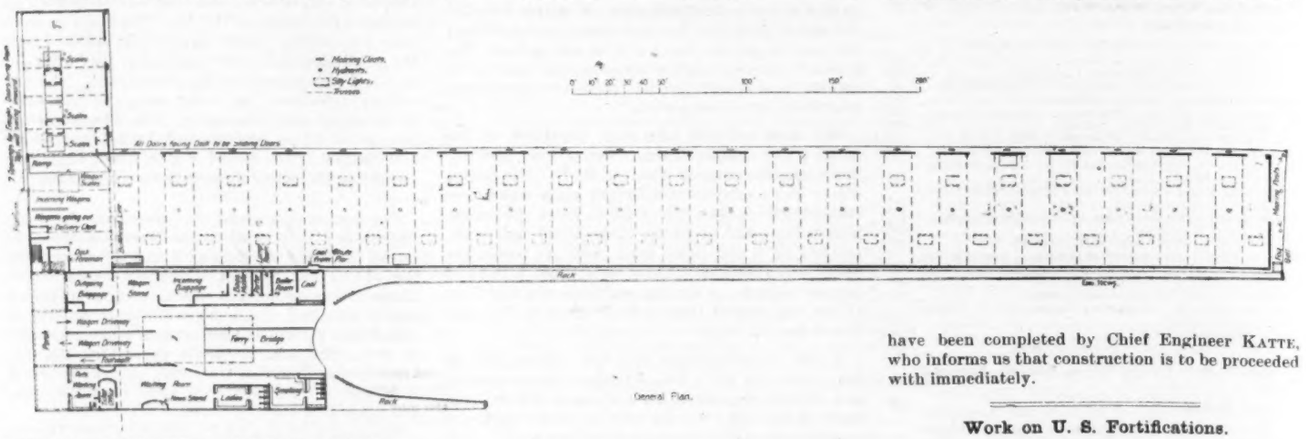
The accompanying drawings show the general plan of the terminal with elevations of the buildings. The facilities for handling freight include a dock 70 ft. wide, extending out 676 ft. from the bulkhead line, and covered by an iron shed, with a two story house on the bulkhead containing scales, driveways, offices for shipping clerk, receiving clerk, car clerk, dock foreman, &c., with a second floor devoted to general freight offices.

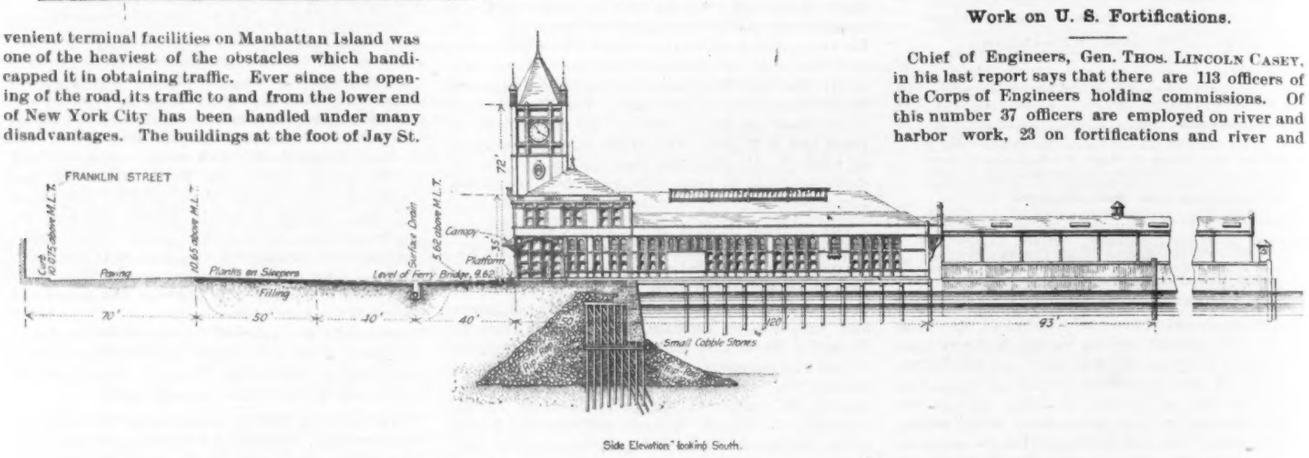
The slip for the passenger ferry boat is on the north side of the freight pier, which is protected from injury by a row of fender piles. The conveniences provided in the passenger station are about those usually arranged, with the addition of a ladies' waiting room and a smoking room. The West St. front of the building is ornamented by a clock tower 22 × 20 ft., the face of the clock being about 60 ft. above the street surface and the spire rising to a height of about 100 ft. This feature is a most commendable one, especially on a road carrying a considerable number of commuters, a class of passengers whose habit of arriving at the ferry very close to the time of departure of the boat connecting with their train is well known.

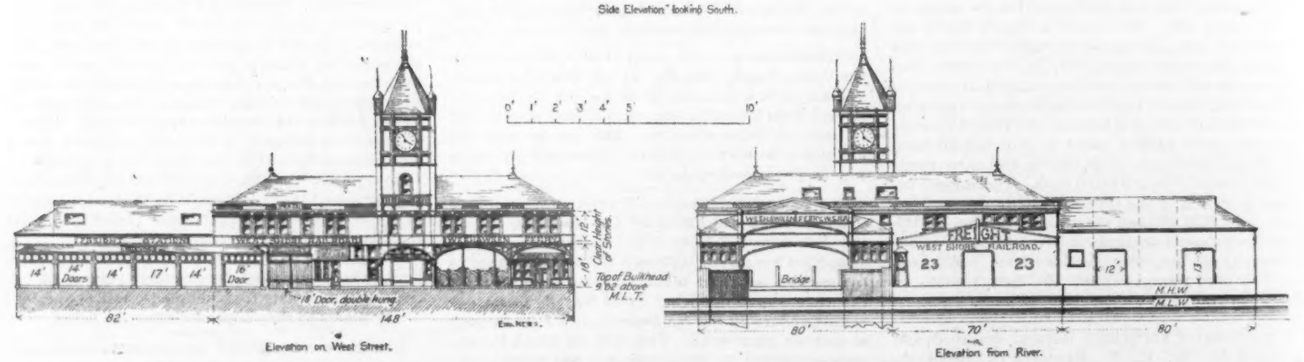
Another noticeable feature of the terminal is the abundant light provided for the passageways to and from the ferry slip by a large skylight in the roof, 63 × 22 ft. in size.

The buildings will be heated by steam; and both gas and electric lights will be provided, with arc lights over the wagon driveways. The frames and roof trusses will be of iron, while the roof and sides will be of galvanized sheet iron. The roof will be covered with Warren's Anchor brand asphalt and gravel.

Besides the West Shore traffic, this terminal will be used by the New York, Ontario & Western Ry., under its lease. The freight pier is already in use, and about 100 carloads of freight per day are being unloaded there. The plans for the whole work have been completed by Chief Engineer KATTE, who informs us that construction is to be proceeded with immediately.







THE NEW TERMINALS FOR THE WEST SHORE RAILROAD, AT THE FOOT OF FRANKLIN ST., ON NORTH RIVER, NEW YORK.

Work on U. S. Fortifications.

Chief of Engineers, Gen. THOS. LINCOLN CASEY, in his last report says that there are 113 officers of the Corps of Engineers holding commissions. Of this number 37 officers are employed on river and harbor work, 23 on fortifications and river and harbor works, 15 in the battalion of engineers and U. S. Engineer School and 16 on detached duty; the remainder are scattered.

In connection with fortifications Gen. CASEY says that for 15 years prior to August, 1890, no appropriations had been made for the construction of sea coast defenses in the United States. In this period great advances were made in the building of ordnance, and guns have been made weighing 100 and 110 tons. The tendency now is to rather decrease the size of guns, and foreign powers are already discussing the substitution of 67-ton guns for those of 110 tons. The time is now propitious for the construction of modern forts. Under the appropriations of Aug. 18, 1890, and Feb. 24, 1891, the sums of $1,-

221,000 and $750,000 are now being expended in new works for high-power guns. The first act appropriates to Boston $235,000; New York, $726,000; San Francisco, $200,000. The second gave $285,349 to New York, $158,848 to Hampton Roads, $117,150 to Washington and $15,000 to San Francisco. The works now under construction are barbette batteries, though the building of turrets, shields and mortar batteries is included in the general project. No works contemplating the use of iron are now being built; concrete, covered with sand, is used to shield the armament and gunners, and the disappearing principle of mounting guns has generally been adopted.

Gen. CASEY submits an estimate of $2,647,000 for gun and mortar batteries. This amount, with sums in hand, will be required to provide emplacements for such armament as will be finished by Jan. 1, 1894. To provide for guns that will be on hand Jan. 1, 1893, the sum of $1,735,000 is needed, while only $750,000 has been appropriated.

For the harbor of New York as planned the defenses of the southern and eastern entrances require, for the present, 19 12-in. guns, 17 10-in, and 9 8-in. guns, 176 12-in. mortars, and submarine mines operated from 5 mining casemates, which latter are completed. Emplacements have been commenced for 2 12-in. and 6 8-in. guns and 32 12-in. mortars. For Boston harbor an emplacement for one 8-in. gun and two 10-in. guns and a battery for 16 mortars have been commenced; whereas, the plan of defense contemplates the placing in position of 12 12-in. guns, 15 10-in. and 5 8-in. guns and 128 12-in. mortars. The same story, or worse, is told for the other important seaports of the United States. The remainder of this report of 476 pages is devoted to river and harbor improvements in the United States too detailed for an abstract in this place.

The Effect of Salt in Mixing Cement Mortar.*

The variance between the results of recent experiments and the conclusions and results announced in text books and earlier engineering papers as regards the relative effect of fresh and salt water upon the strength of cement mortar led the writer to make tests upon the subject the work of a thesis. The tests were begun in February, and were limited to 13 weeks.

In the tests 7 brands of cement were used, 3 of which were Portland and 4 natural cements; 500 briquettes were made of each brand of cement, 200 with fresh water, 200 with salt water, 3% salt, and 100 with salt water, 10% salt; 15 briquettes of each kind were broken at the interval of every week from the time they were made for a period of 13 weeks, excepting those made with a 10% solution, which lasted but 7 weeks.

Making the Briquettes.—The cement was first carefully weighed in small batches from 15 to 20 lbs., depending upon the rapidity with which the cement sets, and placed in a large galvanized iron mixing basin. The water was also carefully weighed and added, the minimum amount being used that would thoroughly mix the cement. The exact percentage of water used may be seen below. The cement was thoroughly mixed by hand. Experiments were made looking toward a machine mixer, but none were found to give as good satisfaction as hand mixing. Experiments with a Jig machine, on the same principle as that described by Mr. A. BENT RUSSELL, C. E., in ENGINEERING NEWS of Jan. 3, 1891, and used by the St. Louis Water Works Extension with alleged good results, showed the cement to be rolled up in small balls or lumps after shaking. Satisfactory results may be obtained with a small quantity of cement sufficient for one briquette, but where the briquettes are machine made and a considerable quantity of cement is required at each mixing, the results are not as good as could be desired. After mixing, the cement was molded into briquettes by the machine designed last year by Prof. JAMESON for that purpose, and described in ENGINEERING NEWS of Feb. 7, 1891. This machine gives a pressure of 150 to 175 lbs. per sq. in., which aids in reducing the amount of water to a minimum. When made, the briquettes were placed in a galvanized iron pan and covered with a damp cloth for 24 hours, and at the end of this time immersed in water in similar pans, those made with fresh water immersed in fresh water, and those made with 3% and 10% solutions in a similar solution. The temperature of the making and immersing rooms was kept at a nearly constant temperature of 60° - 65°.

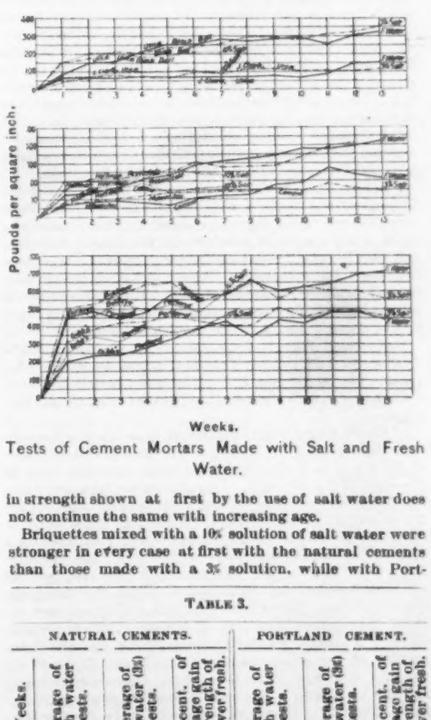
The average breaking strain of the 15 briquettes broken each week was taken as the breaking strain of that cement for that week, and the tables and diagrams made from these strains. They were tested with a Riehlé Bros.' standard cement testing machine, with the addition of rubber buffer clips, which gave the breakage of fully 90% of the briquettes at the minimum section.

* A paper by M. I. POWERS, Jr., '91, Univ. Ia., in *The Transit*.

TABLE OF CEMENTS TESTED, WATER USED AND BRIQUETTES PER POUND OF CEMENT.

No.	Brand.	Kind.	Per cent. Water.	No. B's. per lb.	Address.
A	Utica Black Ball	Natural..	22.3	4	La Salle, Ill.
B	Gibbs' Portland	Art. Port	15.6	3.8	Grays Essex, Eng.
C	Milwaukee.....	Natural...	20.8	4.8	Milwaukee, Wis.
D	Buckeye Portland.	Art. Port.	16.6	3.6	Bellefontaine, O.
E	Utica J. Clark	Natural..	24.1	4.9	Utica, Ill.
F	Hoffman Rosendale	" ...	20.0	4.1	Kingston, N. Y.
G	South Bend Cem.....	Art. Port..	19.2	3.7	South Bend, Ind.

The accompanying diagrams and table [Table omitted.—ED.] show the average breaking results for each week for each kind of cement with fresh and salt water solutions. It will be seen that salt water increases the strength of cements considerably at first, but does not seem to continue the strength, at least not with the same percentage increase as at first, as the cement mortar grows older. By looking at the diagrams, it will be noticed that the line representing the averages of salt water breakages drops below the fresh water line in some of the cements during the last two or three weeks. Here it would be interesting to continue the tests further in order to see if this drop is a permanent one, or whether it is due simply to some irregularity in the cement, which latter is rather improbable. One significant fact is obtained from the diagrams, that the considerable percentage of increase



Tests of Cement Mortars Made with Salt and Fresh Water.

in strength shown at first by the use of salt water does not continue the same with increasing age.

Briquettes mixed with a 10% solution of salt water were stronger in every case at first with the natural cements than those made with a 3% solution, while with Portland cements, with one exception they were weaker. From this and the diagrams showing the averages of Portland and natural cements with salt and fresh water it will be seen that the effect of salt water upon Portland and natural cements is noticeably different.

TABLE 3.

	NATURAL CEMENTS.			PORTLAND CEMENT.		
Weeks.	Average of fresh water tests.	Average of salt water (3%) tests.	Per cent. of average gain in strength of salt over fresh.	Average of fresh water tests.	Average of salt water (3%) tests.	Per cent. of average gain in strength of salt over fresh.
1	86.7	103.9	20	331.9	406.7	22
2	104.0	135.4	30	380.4	506.7	33
3	118.5	152.7	28	376.7	509.0	35
4	143.0	133.1	–7	403.1	550.9	26
5	154.2	170.1	10	492.4	531.7	8
6	180.2	195.3	8	443.5	497.9	10
7	199.7	189.2	–5	508.0	515.0	1
8	200.9	207.3	3	513.9	564.6	10
9	221.8	213.4	–3	532.9	540.0	1
10	233.5	216.7	–8	624.1	543.6	3
11	252.7	247.9	–2	568 2	584.3	3
12	271.2	247.8	–9	582.3	554.3	–5
13	279.8	260.3	–7	578.1	542.6	–6

In ENGINEERING NEWS of Dec. 20, 1890, is a statement of tests which were made by Mr. JOHN GARTLAND, at Governor's Island, New York Harbor, for the purpose of comparing the relative strengths of cement mortar when mixed with fresh and with salt water. From the results of his tests the conclusion is stated that the permanent gain in strength in Rosendale cements due to the use of salt water was about 20%, and in the case of Portland cement not less than 10% permanent gain; 2,531 briquettes were broken and 15 different brands of cement were used. In the tests which form the subject of this paper, 7 different brands of cement were used and 3,500 briquettes broken, thus giving a much larger number of tests for averages than were used in the New York Harbor tests. In the former tests, the gain at first in both natural and Portland cements, taking the averages of the several brands of natural and Portland, was about 30%; but in the third month in both, and in the second month with the natural cements, the gain becomes a minus quantity and the cements become weaker than those mixed with fresh water. Here, too, the results, as shown by Table 3 are sufficiently uniform to show that the variation can scarcely be credited to irregularities in the cements in testing.

There can be no doubt that cement mixed with sea water gains considerably in strength during the first few weeks, but that it does not hold out is clearly proved by these results from the cement laboratories of the University. The gain also seems to be greater and more permanent with the Portland than with the natural cements.

The effect of using a 10% solution seems not so good as with a 3%. The tests were not carried out for the full 13 weeks and cannot be directly compared.

Microscopic Tests of Cement.*

[WITH INSET.]

At present cements are usually tested with a view to determining their tensile strength. It is true that in ordinary practice cements are subject only to compression, but the fact remains that those cements which have given good results in practice have given correspondingly good results when subjected to a series of tests, and *vice versa*, and the results of these tests must be regarded as the most certain available source of information.

But to test any great number of cements by this method involves a considerable outlay, both in time and money, and must usually be carried on at least for several months, on account of the fact that the best cements require a considerable length of time to acquire anything like their maximum hardness, so that tests extending over short periods of time are apt to exaggerate the value of the poorer cements, many of which attain their maximum hardness in a few weeks. All this usually makes it quite impossible for any one having work in charge to make any satisfactory cement tests on his own account, and shows at once the desirability of a method by which one could, at slight expense, obtain even an approximate idea of the relative value of several different cements. As we all know, different cements vary in external appearance, and the thought naturally occurs, May there not be a still further difference in the appearance of the individual particles?

In a translation from Dr. LADENBURG'S *Handwörterbuch der Chemie* (December *Transit*) the statement is made that under the microscope Portland cement appears as a mass of overlapping and interlacing scales, while natural cement consists of a mass of nodular particles. Might not this very marked difference in structure, which is coexistent with a marked difference in quality, be also detected in less degree between the different kinds of natural and Portland cement?

If we have a sufficiently complete series of tensile tests by which the relative value of the cements in question is already established, can we not, then by means of the microscope determine those differences, if any, in appearance and structure, that are interdependent with those differences in quality, and by assigning to these their proper value, obtain a ready and convenient standard by which to judge of the value of any cement? This is the question I have attempted to answer in what follows:

It may be well to begin by defining the meaning of the term cement; a cement is usually defined as an hydraulic substance, produced by the burning of a natural or artificial mixture of calcium carbonate or oxide, with some siliceous material, and according to the commonly accepted classification, natural cements are those in which this burning process has not been carried to the point of vitrification, while Portland cements are those which have been vitrified in burning. Thus it will be seen how much the temperature of burning affects the quality of the cement.

Then, beside this, the proportion in which the ingredients of the raw materials are combined in the mixture from which the cement is burned, and also their physical condition, are of equal importance.

In the ideal cement we will have one in which the physical and chemical condition, and the proportion of the ingredients are such that when they are chemically combined with one another, they will just be sufficient to form the substance or substances to which the setting of the cement is due, and the burning must be carried on at such a temperature as to just produce the desired chemical effect, no more and no less.

As a consequence of this, the conditions which are apt

* A paper by ALDEN H. BROWN, '91, Univ., Ia., in *The Transit*. [NOTE: The different brands of cements referred to in this paper will be seen to be the same as those whose physical properties, as determined by the more ordinary and elaborate methods of testing, are given in another paper of this issue.—ED.]

to affect a cement injuriously are underburning, overburning, improper proportioning of the ingredients or the presence of inert foreign substances.

If we take a little dry cement on a microscope slide, spread it thin and examine it with an objective of considerable power, the difference in the appearance of the different cements is very well brought out.

Plate 1 shows some Buckeye cement treated in this way. As will be noticed, the particles are sharp and clearly defined, and are apparently of homogeneous texture; all the particles, whether large or small, have the same general appearance. By a proper manipulation of the microscope it may be shown that the particles both reflect and transmit light, thus indicating that the mass has been completely vitrified. The uniformity in the appearance of the particles shows that either there are no foreign substances present or that they are not in sufficient quantity to be visible. Up to the present time this cement has given the best results of any that have been tested in the University laboratory.

Plate 2 shows Gibb's Portland cement. The general appearance is much the same, and at first sight might be said to be identical except for the difference in the distribution of the particles, which is, of course, purely accidental; but if we look closer we will see that the particles are not quite so clear as in the preceding case, and that there are quite a number of minute rounded particles which are entirely different in appearance from the particles of cement which surround them. These are probably small beads of glass, formed during the burning process, from free silica existing in the clay from which the cement is made. This, as is well known, exerts an injurious effect on the quality of the cement, by introducing an inert foreign substance, which interferes with the setting of the cement. The slight opacity of the particles of the cement may be due to the admixture of some foreign substance, or to some fault in the burning.

Plate 3 shows the South Bend cement. This appears to be almost identical with the one last described, except, perhaps, that some of the particles are rather coarse. Both the Gibb's and South Bend cements have given excellent tests, although not equal to the Buckeye.

Plate 4 shows the Rosendale cement, which, according to the tests made last year, has the greatest tensile strength of any of the natural cements. As we should expect, it is very different in appearance from any of the artificial cements we have just described. The fact that it has not been completely vitrified will account for the opacity and indistinctness of the particles; still it is quite homogeneous in appearance and is much more vitreous in structure than any of the other natural cements.

Plates 5 and 6 show the Utica Black Ball cement and J. Clark's Utica cement. These are almost identical in appearance, consisting of opaque masses, surrounded by numerous minute glassy particles. Some of these particles are rounded and are probably similar to those we have already noticed. There are others, however, with a sharp, angular outline. These are probably due to the vitrification of some portion of the cement material.

Plate 7 shows the Milwaukee cement. There is little, if any, distinctness in the individual particles, which are collected in opaque masses, and the particles themselves are almost entirely opaque This cement did not give as good results as the others mentioned.

Plates 8-14 show these same cements taken in the same order, except that in this case the cement has been treated with water and allowed to set on the slide

In all these it will be noticed that the clear particles have arranged themselves together in some sort of regularity, while the opaque masses have remained practically unchanged. This is especially well shown in Plates 8, 9-10.

In conclusion, I think that I am not claiming too much when I say that I believe that the relative values of any two cements may be determined by a microscopic examination by observing the following rules:

1. See which cement has the greatest angular, vitreous particles.
2. Notice the transparency of the particles.
3. Notice the amount of foreign matter present.

European Street Railway Practice.

Mr. OSBORNE HOWES, Jr., Rapid Transit Commissioner, submitted to the Boston Rapid Transit Commission, on the 10th inst., an elaborate report on the transportation of passengers in and around the cities of Europe, containing a great deal of interesting detail in regard to foreign

The report is subdivided under the following heads, which are taken up in order:

1. Street cars, and the conditions controlling their operations.
2. Underground roads.
3. Elevated roads.
4. Terminal facilities of steam railroads.
5. Rates of fare, zone system of charges and general effect of better methods of transportation in encouraging suburban travel.
6. Street widenings.

The first part of the report, that devoted to street railways, is in some respects of especial interest from the painful contrast which exists between the good management of European cities and the bad management of our own. The following is the substance of this part of the report somewhat condensed:

As a rule, with few if any exceptions, in the franchises granted to street railways in England and the continent, the government, either national or municipal, reserves to itself the right to fix the rates of fare and the number of trips which shall be run during the day and night; to decide the form of track that shall be used, and the part which the companies shall pay of the expense of paving, cleaning and watering the streets through which the tracks run, and, finally, to purchase the entire plant, either at any time or at the end of a fixed period. In other words, many of the rights which the American municipalities have surrendered to street railway companies, the municipalities of the Old World have jealously retained.

Liverpool Tramways are all owned by the municipal corporation, which some years ago purchased and reconstructed the then existing lines, and has since considerably extended them. It has now the ownership of about 50 miles of single track road, all of which is leased for 25 years, on a payment of approximately 10% per annum on the cost of construction, which, for the purposes of the lease, is arbitrarily fixed at $30,000 per mile, as this is estimated to be a fair average. By the terms of this agreement the city agrees to keep the tracks in order, leaving to the tramways company the sole duty of moving the cars. This lease terminates in 1894—for all of the newly constructed track is included under it—and as by means of it, it has been possible for the tramways company to pay considerable annual dividends upon a capital largely increased by the issue of watered stock, there is a strong popular demand that the city government shall take and administer this business as one of the municipal functions.

Possibly, in view of the short time in which the present lease expires and the doubts as to its renewal, the tramways company feels under no obligation to keep its service up to a high point of comfort and efficiency. Certainly the cars it runs are not particularly clean or otherwise inviting in appearance. They are all of the double decked structure, as are practically all of the tramcars on all the English lines, and usually have a carrying capacity of 18 inside and the same number outside.

The usual fare is 4 cts. inside or outside, though during apart of the day 6 cts. is charged on some of the lines. The omnibuses, which in certain instances run in competition with the tramcars, charge as a rate of fare 2 cts.

At places where large numbers of passengers ordinarily take the cars, the line of the tracks—usually in the middle of the street—is deflected so as to bring the cars close to the curb of the sidewalk. This change can be made without inconvenience in Liverpool, because of the unobstructive character of the track itself, and the equally unobstructive manner in which it is put down. The upper contour of these tracks resembles the letter U. The bearing rim or surface for the wheel is small, as is also, both in width and depth, the indentation in which the flange of the wheel runs. These tracks are laid so that no part of them rises above the surface of the street. They are put down in a manner which ties the track and the immediate surface of the street together; and while all kinds of vehicles can cross over them at any angle, with hardly any jar or strain, it is asserted that but comparatively little difficulty is experienced in winter in freeing the tracks from ice and snow, though there is, of course, less of these obstructions to contend with than are met with during an average winter in Boston.

In the opinion of the City Surveyor of Liverpool, who has immediate charge of tramway construction matters, there is no present probability of the introduction there of electric or cable lines. While the people may not be wholly satisfied with the street transit facilities now furnished, the city government would seriously oppose any project which led to the tearing up of the pavements in the principal streets, as would be necessary to put down a cable or electric wire conduit, for overhead wires would not be permitted. These pavements have been put down in a careful manner, at an expense of about $5 per sq. yd., and in the judgment of the surveyor, if the surface was disturbed in order to lay new tracks, or a conduit, it would be necessary to repave the entire street from curb to curb in order to obtain complete uniformity of surface.

I may add, by way of note, that this Liverpool opinion, that when a street surface is in part disturbed it is necessary, in order to obtain an equally good pavement in the future, to repave the entire surface, is not shared by those having charge of street work in Manchester and Birmingham.

Manchester Tramways.—There are in Manchester about 50 miles of street track built by the city, which began the work of construction some 15 years ago. In 1877 these tracks were leased to the company which now operates them for a term of 21 years, the lease to cover all new construction which might subsequently be undertaken. The first lines of track laid were leased at 10% on an estimated cost of $50,000 per mile of single track. This it may be assumed was an arbitrary amount, considerably in excess of cost, named because the routes first established were those running through the center of the city and hence specially profitable ones. The extensions which have since been made, and which have been covered by the general lease, have been less productive in returns to the municipal treasury, the rent received on an assumed 10% of cost varying from $1,500 to $2,250 per annum per single mile of track. The municipal government decides when and where the tracks shall be laid, and, although it cannot force the company, which has generally leased these, to take a new line of tracks, an agreement on this head is generally reached before the work of new construction is begun. It is this that, no doubt, accounts for the different rates at which parts of the lease have been made, as the actual cost of new construction, as given by the City Surveyor, is $12,500 per mile of single track, this including the replacement of the pavement for 18 ins. on either side outside the track. The city receives for its 50 miles of single track, approximately, $100,000 per annum, but it is compelled to keep the streets and tracks in serviceable condition, and to remove the snow and ice in winter, though this latter service was not contemplated by the city when the lease was made.

The fares are based upon a sliding scale, graded by distance traveled, and run from 2 cts. to 12 cts. The latter covers a distance of about 6 miles. The great majority of the fares collected are 2 and 4 cts.

By the terms of the lease the company is under no obligation in the matters of the number and time of running its cars. City ordinance restricts the number of persons carried in or on a car to its seating capacity, that is, 18 persons inside and 20 on top, and the company would be heavily fined if the law was persistently violated; but in spite of the law and the risk involved in ignoring it, in stormy weather and under certain conditions—excursions into the country, for example—it is not infrequently violated. But it is assumed that if the number that a single car can carry is restricted, the dictates of self-interest will force the company to put on a sufficient number of cars and run a sufficient number of trips to earn the largest possible income.

In laying out the routes the city authorities have endeavored to have but one line of track in a street, that is, to have the cars go and return on different streets. In the center of the city, to which all of the lines converge, Market street and Piccadilly are broad thoroughfares, and here there are three lines of track, which interfere but little with the ordinary street traffic.

The men have to work for 12 hours per day, at times most convenient to the company; but, although paid at the rate of $1.12 per day for 7 days in a week, they are employed only 5 days out of that time. That is, they are given 2 days' rest each week without loss of pay.

Birmingham Tramways.—About 40 miles of single track; owned by the municipality, some of them having been built by it and others purchased and rebuilt. The average cost per mile of single track for construction has been $25,000. There are four different systems, viz.: steam, electric, cable and horse cars. The street cars propelled by dummy engines represent the greater part of the mileage. This system is tolerated because it was, when introduced, the best possible means of rapid transit, but it is unlikely that official approval could now be obtained to extend this method. The speed is limited to 8 miles per hour by law, but at night, and at other times when the streets forming the route are free from obstructions, the rate of speed attained is apparently considerably in excess of the limit.

The cable cars have a speed of 9 miles per hour, the electric cars (storage battery) 7 miles and the horse cars nominally 6 miles. The street railways do not pass into or through the center of the city. The streets in that section are not particularly broad, and it has been thought expedient to describe in the center of the city a circle, having a diameter of about half a mile, within which no street car tracks are permitted. One effect of this is to prevent the direct transfer by street cars of passengers from one outlying section of the city to the other.

The leases of the various roads have been given out, without competition, to the companies that now hold them, for a term of 21 years, these leases including such extensions as the municipality may from time to time construct. Under the terms of these contracts the companies agree for 14 years to pay annually, in addition to all parish, municipal and national taxes that may be regularly imposed, 4% of the gross cost of constructing the tracks, including in this cost the expense of paving or repairing between the tracks and for 21 ins. on either side. For the succeeding 7 years the rate of payment is 5% of the gross cost. Besides this, the companies pay for all repairs that the city officials consider it necessary to make on the tracks or the road surface in its immediate vicinity. The possible extent of this last commitment may be judged when it is said that last year a line of railroad of 4 miles in length had assessed upon it bills for street repairs made by the city amounting to $50,000. This caused the

company to make a protest, and there was some intention of testing the legality or equity of the assessment; but, after taking competent legal advice, the company came to the conclusion that there was no appeal from any decision of this kind arrived at by the authorized agents of the city.

The rental charge is paid into the municipal treasury in monthly installments. The repair charges are paid each quarter, when accounts are made up and sent to the various interested companies by the municipal officials. If bills due either for rent or repairs are not paid with reasonable promptness the city government has it in its power, in the case of the greater part of the companies, to bring a direct pressure to bear upon them. The right to use any other power than horse power is only granted by the city for a term of six months at a time, renewable, of course, at the end of that period. Where in one or two instances a railroad company has failed to make its payments at the required time, the intimation that its privilege to use steam power would not be renewed has been all that was needed to force an immediate settlement of the account.

The companies are compelled to keep their tracks free from snow. As in Liverpool and Manchester, the tracks are, as nearly as possible, on a level with the surface of the street pavement, though the form of rail used in Birmingham and Manchester differs from that used in Liverpool, having a broader surface for the car wheel to run upon. The City Surveyor of Birmingham doubts whether the form of rail used by his city is as satisfactory as that adopted in Liverpool. There are quite a number of accidents occurring monthly, such as the breaking of axles, wheels, &c., in consequence of the obstruction to street travel caused by rails, for which compensation is claimed from the city, and hence it is good economy for the city to adopt the type of rail which approximates nearest to the ordinary street service.

Penny fares prevail throughout Birmingham. These apply to single stages, which average about 1¼ miles each. At the beginning of each stage the fares are collected for that stage, or the passenger wishing to go more than one stage receives a ticket with a hole in it for each penny paid or each stage to be traveled.

There is no rule regulating the number of cars that the companies shall run. Seats must be provided for all who ride, and it is the duty of the police to enforce this law, and fines for violation are imposed with more or less frequency. Self-interest, it is assumed, will cause the companies to run all the cars that are needed to obtain the largest number of passengers.

The Birmingham tramway companies have done during the last few years a highly profitable business. The principal company has paid a regular annual dividend of 10%, and has accumulated a reserve equal to nearly 5% of its capital stock. The others have been somewhat less fortunate, particularly the horse car lines; but all have made at least fair returns to their shareholders.

The overhead wire system will not, it is said, be permitted in Birmingham; but the line which now operates its cars by cable proposes to establish an overhead electric system on a line which it has outside of the city, and which it proposes to extend through several towns. The cars will be run by cable in Birmingham, and by overhead electric wire outside the city border. It is also proposed to run another line by compressed air, at a pressure of 120 lbs. per sq. in., and applied by means of a new principle. The power is to be supplied to the car at intervals of, say, one-quarter of a mile, the time consumed in recharging the cylinders averaging not over 30 seconds.

In spite of the small rails, level with the pavement, it is said that the horse, steam, cable and electric cars rarely run off the tracks.

The following general rules [established by the Board of Trade.—Ed.] apply to the construction, use and maintenance of street railways in a large number of cities and towns of Great Britain. Double lines of tramways are to be laid in no street where the width is insufficient to give a space of at least 9 ft. 6 ins. between the outside of the footpath on either side of the street and the nearest rail of the tramway.

City and town authorities, by means of their own carriages and trucks, can make use, free of toll, of the tramways at any time between 12 night and 6 A. M., for the conveyance of scavengering stuff, road material, night soil, etc.

Every engine used on the tramways shall have such mechancial appliance for starting and stopping as may be approved by the board of trade, shall have its number shown in some conspicuous place, and shall be fitted with an indicator by means of which the speed shall be shown, a suitable fender to push aside obstructions, a special warning bell, with a seat for the driver, so placed in front of the engine as to command the fullest possible view of the road before him. The speed at which such engines may be driven shall not exceed the rate of 8 miles an hour.

The money received from time to time from the tramway companies by the local authorities shall be applied by them toward the expenses of repairing, improving and maintaining the highways within their districts, having regard, in the first instance, to the requirements of the roads upon which the tramways are laid.

The rails of tramways shall be such as the Board of Trade may approve, and the Board may require the tramway companies to adopt and apply such improvements in the tramways, including the rails thereof, as experience may from time to time suggest, having regard to the greater security of the public and advantage to the ordinary traffic.

The tramway companies shall pave and maintain so much of any road as extends 2 ft. 1 in. beyond the rails of and on each side of any such tramway, and shall pave and maintain the whole width of any road where it is proposed that a space less than 9 ft. 6 ins. shall intervene between the outside of the foot path on either side of the road and the nearest rail of the tramway.

If, in the judgment of the local authorities, the needed road repairs are not made by the tramway companies, it shall be lawful for said local authorities to stop the tramway traffic along any such part of the road as may be out of repair.

All changes of sewers, water mains, gas pipes, etc., made necessary by the construction of a tramway must be made at the expense of the tramway company.

Tramways built or owned by a municipal corporation may be leased for a term of 21 years to companies desirous of operating them.

Companies are authorized with the approval of local authorities to lay out penny stages, when such tramways are worked by other than animal power, these stages not to exceed one mile in length or distance, and may demand and take from each passenger 1d. per stage or fraction of a stage.

At any time after a tramway has been in operation for three years, the Board of Trade may, at the request of local authorities or interested ratepayers to the number of 20, revise and change the tolls and charges of a company.

If a municipal corporation shall, at the expiration of the twelfth year after the passing of the act of 1882, or within 6 mos. thereafter, give notice to a company of its intention to purchase its tramway, the city shall pay to the company aforesaid a sum equal to the expended capital and the then liabilities of the company, with an additional sum of money sufficient to make up average dividends at the rate of 6% per annum to the shareholders from the time or times the tramways shall have been opened for traffic up to the completion of the purchase, if dividends at that average rate of 6% per annum shall not have been paid out of the profits of the company.

After 12 years, if a tramway is purchased by the municipality, it is necessary to pay the same as above, and the equal of 7% per annum to the shareholders, for the years following the 12th up to the completion of the purchase, if dividends of an equivalent amount have not already been paid out of the profits.

The Street Railways of Berlin have only horse traction. It is the wish of the municipal authorities to have electricity, by the conduit system, substituted, but the chief company is unwilling to incur this increased expense, for the reason that after a number of years the street constructions of all kinds revert to the city, and the company does not care to forfeit an unnecessary amount of property by investing the fresh capital needed to make these improvements. The Grossen company controls all of the street railroad tracks of the city, with a trifling exception. It owns about 180 miles of single track, has about 1,000 cars and 5,000 horses. Last year it carried in round numbers 121,000,000 passengers, an increase of 6,800,000 over those carried during the previous year. The company holds its concession until 1911, when all of its tracks pass into the possession of the city. It will then still retain its horses and rolling stock, and such real estate as it may own. The company puts down its own tracks, but must use the type of rail that the city authorities direct, and must put this down in a manner to meet in all respects official approval. The company must pay for all changes that the laying of the tracks necessitate in water mains, sewers, gas pipes, &c., and must, moreover, pay whatever expense for street repairs the city authorities consider to be its share. Before undertaking any extensive work to which the company must contribute, the city authorities usually lay the matter before the officers of the company, as a matter of courtesy merely.

The company has to pay for its use of the public streets a tax upon its gross income of 4%, when this income is but $1,500,000 or under, and ascending to 8% tax per annum when the gross income is $3,750,000 or over. The company paid of last year's receipts 7¾% to the government, or $247,625. Beside this, the company has to pay a tax on all of its real estate, an income tax on its declared profits over 4%, and in addition its stockholders have to pay an income tax on their dividends, as though the company had paid nothing. In other words, the company is taxed, in addition to what it pays in the way of compensation for street franchise, precisely as any other industrial company in Germany would be taxed.

The city authorities reserve to themselves the right to regulate the rates of fare and the time table of trips. The President of the company says that the municipal authorities could make him run his cars every three minutes throughout the night by simply ordering him so to do, and a failure on his part to comply would lead to the imposition of large fines. The company cannot carry in any car more than its seating capacity, and if it failed to provide a sufficient number of cars for ordinary demands the municipal authorities would instantly cause the omission to be made a matter of official inquiry. The rates of fare are determined by distance, and are 2½, 3¾, 5 and 7½ cts.; 75%, 15%, 5% and 5% of all the fares are at these several rates. The average length of a trip for 2½ cts. is 2 miles. Dividends have been paid for a number of years past of 12½ cts. per annum.

The capital of the company is $4,275,000. There is also a bonded debt of more than $4,000,000. The policy of the company has been to each year set aside a sum of money, the aggregate to be turned over to the stockholders at the end of the concession, to make good the loss occasioned by the forfeiture of the corporate property. On the present basis of savings it is estimated that each shareholder will receive, when the period of concession ends, $200 for each $100 of stock held by them. The shares of the company have been recently selling at the equivalent of $220 for a $100 share, though the price has been at other times as high as $250 per share.

There is a strong competition going on between the street railway lines and the state steam railway lines. The policy of the latter to reduce their rates of fare and improve their facilities is forcing the street railways in self-defense to offer larger inducement in the way of fares and more frequent trips.

Berlin is growing in population more rapidly than Chicago, and it is believed the many thousands of acres of unoccupied land in the suburbs will soon be covered with tens of thousands of small buildings, occupied by one, or at most two, families.

The officers of the Berlin street railway assert that although the government of the city is exceedingly exacting, it is absolutely impartial and disinterested. Not a cent has to be paid for legal fees or lobby expenses of any sort. To offer a secret inducement of any kind would be to provoke serious consequences. This comment is made because in Vienna, Paris and some other European cities personal influence and the judicious use of money are potent factors in the drafting and enforcement of laws permitting and regulating the use of streets by railway companies.

Street Railways at Buda-Pesth.—This city, of about 500,000 people, is the only one in Europe that has a direct working electric railway. There are three of these lines already in operation, and a fourth, on a new system, will probably be built next year. The wires furnishing the current for the cars are in a conduit underground, access to which is obtained by using a split rail for one of the tracks. The entire equipment was supplied by the Siemens & Halske Co. The nominal rate of speed is 8 miles per hour, but at night, or at certain parts of the routes where there are substantially track reservations in the streets, the speed attained is from 10 to 12 miles per hour. The price for a trip in the electric and horse cars is 2½ cts. for an average distance of 2 miles. It is said that the electric cars at Buda-Pesth experienced no more trouble with snow and ice last winter than the ordinary horse cars. There was some delay, but nothing serious, although last winter was one of exceptional severity in Hungary, and the Danube River was frozen over continuously for more than three months.

The electric and horse cars in Buda-Pesth are not allowed to go in the center of the city on the north side of the river. A space of about two thirds of a mile long and half-mile wide is kept free from tracks. Exchange tickets are sold by the lines which admit of transfer, but those going in a direct line across the city would be compelled to walk or take some other form of conveyance for a part of the distance.

The new line, which it is proposed to build next year, is planned on a wholly new system. The invention is controlled by Messrs. Ganz & Co., who have large workshops at Buda-Pesth where they give employment to several thousand persons. The car runs upon a single split rail, drawing its supply of electricity and obtaining its support from a conduit reached through the open space between the two sections of the rail. By this means the disfigurement of the street surface is reduced to a minimum, in fact is done away with, and it is claimed that relatively less trouble than at present would be experienced in keeping the lines free from the obstructions of snow and ice. Besides this, the cost of street repairs would be very slight. The cost of building and equipping a line of this kind is estimated at $39,000 per mile, this not including central power stations. Messrs. Ganz have an automatic device by which the cars themselves turn the switches, when a single track with turnout is employed.

Tramways in Vienna.—These are very thoroughly reported upon by United States Consul GOLDSMITH in his recent letter to the State Department, which will soon be printed in the consular reports. In addition all that needs to be said is that the tracks are not laid in any street within the Ring-Strasse, which surrounds the center of the city.

We shall, next week, give a more condensed abstract of the rest of this report, relating to underground and elevated railways, &c.

Experiments Upon the Velocity of Steam.*

A series of observations upon the peculiar shapes assumed by a jet of steam upon issuing from orifices of different forms, led the writer to the supposition that a discharging nozzle could be so proportioned as to give the maximum efficiency of expansion under given conditions, and numerous experiments were therefore made to determine the internal pressure and velocity of the steam at different sections of tubes of various shapes. The results obtained at 30, 60, 90, and 120 lbs. initial gage pressure are shown by diagrams and tables accompanying the paper, and indicate very interesting results, while the characteristics of some of the tubes are quite marked. As might be expected, a cylindrical nozzle is shown to be the least efficient, and the terminal velocity of the steam in this tube is found to be the same as at the initial section of the tubes with divergent taper. In the latter style of tube, the steam has more opportunity for expansion, and the terminal velocity approaches more closely the theoretical value.

A peculiar circumstance is noted in the text and made very apparent by the diagrams, viz: that in a well proportioned nozzle or thin diaphragm, the actual velocity of discharge at the minimum section is very nearly constant for all the pressure of steam used in the tests; and for any other section of the tube, the same condition obtains as long as the expansion is continued. This qualification seems to be necessary, as several instances are given where the expansion within the nozzle falls far below the atmospheric pressure, and subsequent contraction causes a loss of velocity.

This fact of constant velocity of discharge under certain conditions is commented upon at some length and shown to give good ground for the use of Napier's formula for discharge of weight of steam, with the suggestion that the use of the initial density of steam instead of the absolute pressure might give even more accurate results.

* Abstract of a paper by STRICKLAND L. KNEASS, in *The Proceedings of the Engineers' Club of Philadelphia*, Vol. VIII, No. 3.

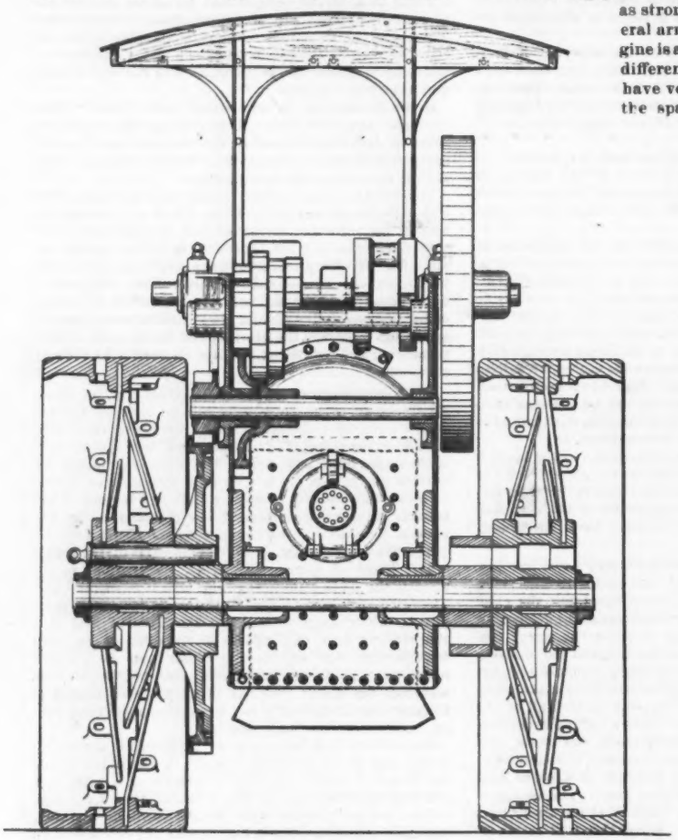
A New Steam Road Roller.

(WITH INSET.)

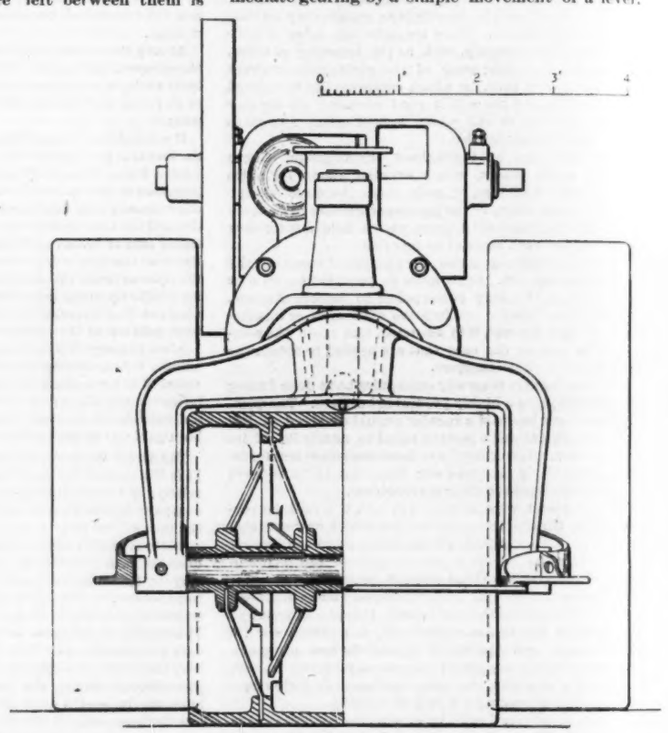
The machine shown in our inset and by supplemental cuts is specially designed for road making; that is rolling, plowing, breaking up top surface of worn-out roads, rolling roadbeds for paving, driving stone crushers and other machinery. It can also be used as a locomotive to convey material to the point of use.

As will be seen, the rollers are made as large and heavy as is practicable in a machine of its weight; for by so doing the roller has more bearing surface and is not likely to sink in soft places, and it rolls easier and does not push the material in front of it in a wave. The wide roller wear more slowly and require less power to drive them, and being heavy they absorb sudden shocks on rough roads and the consequent wear and tear on boilers and gearing.

The working parts are few in number and made as strong as possible, and the general arrangement of a traction engine is adopted, with the following differences: The driving wheels have very wide, smooth faces and the space left between them is covered by another pair of rollers which carry the front part of the machine and act as steering wheels and yet accommodate the machine to the inequalities of the road by the device shown in detail. The rear rollers are 85 ins., or the extreme width of the machine, consequently the machine can work close to curbs, lamp posts, &c.



SECTION THROUGH MAIN ROLLERS.

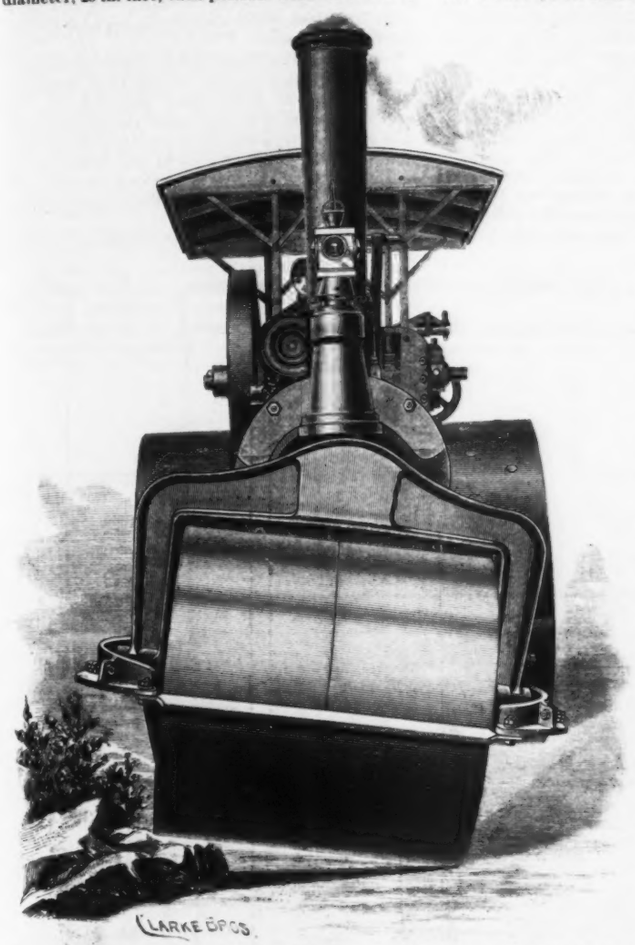


SECTIONAL FRONT ELEVATION.

The boiler is of the locomotive type, made of 5/16-in., best flange steel plates of 60,000 lbs. tensile strength, and has every seam double riveted. It is tested to a pressure of 200 lbs. per sq. in. and is jacketed with wood and Russia iron. The firebox plates are 7/16 in., the tube sheets are 7/16 in. The firebox is made very deep in order to carry a thick fire. By this provision frequent firing is not required, which gives the operator more time to work the machine, and above all prevents to a great extent the smoke nuisance when at work. An air-tight ashpan is fitted with two dampers so as to regulate the draft very easily. The firebars are made very heavy and have a large space between them and the ashes. This prevents burnt or twisted firebars. The whole of the firebox is stayed every 4 in. by best stay bolt iron, this part being really stronger than the shell. The outside sheets are extended upward and backward of the boiler. To these extensions are riveted brackets containing bearings for carrying crank shaft, intermediate shafts and main axle. All these necessary bearings are bored out in the lathe. The front and back end of these brackets are securely connected together by a spectacle plate and guard plate respectively, which in turn are fastened securely to the boiler crown sheet, thus making the whole of the bearings in a rigid box; a very strong combination, which effectually resists all injury by jarring, &c. The crank shaft and all intermediate gearing is made to work inside this box between the bearings, whilst the flywheel, for running the belt backward or forward, is close up to the bearing—the best possible position. All the gearing is of crucible steel. The teeth are constructed on the involute principle, by means of which the smooth working of the gears is not affected by wear of bearings or shaft, which must necessarily take place in course of time. All the shafting is of steel, running in gun metal bearings. The crank shaft brasses are made to adjust in the most efficient manner. The crank shaft is of steel, counterbalanced opposite the throw—the best place. A double pinion is fitted on it, which is capable of being entirely disengaged from the intermediate gearing by a simple movement of a lever. This provision allows the crank shaft to revolve alone within its bearings, as is required when running a belt from the flywheel. Two speeds are provided for in this machine: One moderately fast, to enable the engine to travel without loss of time from place to place, and to be used on ordinary occasions or after the road is partly consolidated, when very much less power is required; the other, which is much slower, giving a corresponding increase of power without raising the pressure of steam, and which is sufficiently powerful to drive the roller over thick and loose layers of stone, start it and work on the steepest hills (16 ft. to 100), or lift itself out of the holes where a single speed roller would be effectually stuck, and lastly for use in plowing when the flywheel can revolve moderately fast, and yet the engine move slowly, making it quite easy to guide and handle the plow behind.

A light, substantial awning, 6 ft. long, 6 ft. wide and 7 ft. high, is placed over the foot plate to protect the operator from sun and rain. A powerful brake is attached to the fly wheel, easily and rapidly worked from foot plate. The steering-wheel is placed on the left hand side of the machine, in the best position for the operator to see what he is pass-

ing. The cylinder is placed on the forward part of machine; is fitted with plain slide valve, top safety valve, a Waters' governor for use when driving any machinery, Stephenson's link motion for reversing, and sight feed lubricator. The driving rollers are 6 ft. diameter, 20 in. face, each pierced with 28 holes to receive as many spikes; these spikes project 4¼ ins. from the face of wheel and are used in breaking up the ground in a most effective manner. They are, in fact, the most efficient tool known for the purpose. The whole 56 spikes can be used at one time if required. When rolling, these spike holes are filled with suitable plugs so as to make the face of wheel smooth. Both wheels are driven from main axle, and are so arranged that by drawing out a pin in either wheel one or both are driven or both are disengaged. This enables the machine to make short curves easily.



Front View in Perspective of Springfield Steam Road Roller: the O. S. Kelly Co., Manufacturers.

The front rollers and fore carriage (for which letters patent are applied) are an entirely new departure from that of other makers, are very simple, strong and contain only the very fewest possible pieces to accomplish the end. The smokebox end of the boiler is fitted with a very strong ring securely riveted, which stiffens the boiler in the place most needing it. The saddle casting containing the king post fits against this ring and is held securely by 1¼-in. bolts. A door is provided in this casting to sweep flues, &c. This arrangement does not cut away the end of the boiler, shorten the smokebox or weaken the shell plate, but instead increases the depth of smokebox and increases enormously the strength of the shell plate, and the faces of the ring and casting being flat a perfect bearing is made. When the smokebox is encircled or partly encircled, expansion or contraction causes cracked castings, more especially in the case when the whole smokebox is boxed in. All this is carefully avoided in the new plan.

The kingpost is made of steel cast into the saddle casting. It has no motion, but simply acts as a strong pin for the fore-carriage. On it is fitted a swivel block, which is again fitted to the fork containing the front rollers in such manner as to permit the steering of the machine and accommodate it to inequalities in the road. These front rollers are in two sections, 4 ft. diameter and 24 in. face, revolving in gun metal bushings independently of each other. This is better than a greater number of sections, as each joint permits liquid mud to drop down and quickly destroy the bushings were they not protected by mud guards, as on this machine.

Two water tanks are fitted, the larger one between the rear driving wheels, where it acts also as a foot plate for the operator, and carries a coal bunker with 500 lbs. capacity. This large tank holds 175 galls., and two injectors connected with it feed the boiler. The front tank, 150 galls. capacity, is between the front and rear wheels and under the boiler. It is divided so as to form two large tool boxes on its top and is connected with the rear tank by a large pipe fitted with a valve worked from the foot plate. This front tank is fitted with two sprinklers, operated independently, one for each driving wheel, which water the part of the road being rolled. This is a special patenteed feature and the whole 375 galls. of water carried can be used for this purpose if required. The large water capacity may also be used as ballast to lighten or increase the weight of the machine to the extent of one ton and still leave 75 galls. for the two hours' moderate working. On ordinary occasions the contents of both tanks will last from 7 to 10 hours, a very useful feature on roads remote from a water supply.

The drawbar proper is made of channel iron and extends completely across the rear of the machine, and is fastened to the rear end of the rear tank. For use in plowing an extension drawbar can be employed, thus enabling the plow to follow the extreme outside edge of either of the driving wheels. The drop-pin in the drawbar can be used on either side and on the center, and the turning of sharp curves is thus facilitated. Scrapers are fitted to the front and back of all wheels; but they are not pressed upward by a weight, as usual, nor do they rub and wear out the wheel.

The special advantages claimed in this machine and as peculiar to it are: Superior front carriage, extension drawbar, large boiler and water capacity, large diameter front and back wheels, broad-faced flywheel with counter-balanced crankshaft, sprinklers, ability to roll close to curb, deep firebox and ashpit, double-speed gearing, cab, governor and tool boxes. The rollers are made by The O. S. Kelly Co., of Springfield, O., in three sizes of 10, 12½ and 15 tons.

Rapid Transit Discussed at the Commonwealth Club.

Rapid transit in New York was discussed by the Commonwealth Club and invited guests at a dinner given on Nov. 13. Mr. WM. J. COOMBS presided and among those present were the following well known engineers: Messrs. THEO. COOPER, WALTER KATTE, GEO. W. MCNULTY, J. M. WILSON, C. C. MARTIN, O. F. NICHOLS, W. R. HUTTON, W. G. HAMILTON, W. BARCLAY PARSONS, FOSTER CROWELL, G. S. GREENE, Jr., FRANCIS CALLINGWOOD and J. J. R. CROES. There were also present Hon. CARL SCHURZ, Hon. ABRAM S. HEWITT, Hon. DORMAN B. EATON, JOHN L. MOTT, JOHN E. FITZGERALD, Rapid Transit Commissioner of Boston, and BURTON H. HARRISON.

Mr. CROES made the speech of the evening, and in the course of his remarks noted the fact that into a territory of half a square mile in down town New York the present elevated roads bring each morning and take away each evening about 130,000 people. North of this territory is another strip, 1 mile long and from 1 to 3 miles wide, that absorbs daily in the same way about 65,000 people; and still further north is another strip of about the same size that has carried to it and taken from it another 65,000 every morning and evening. Beyond all this is the residence quarter, 2 miles wide and extending 6 miles to the Harlem; and north of this again is an as yet sparsely populated tract 3½ miles wide and 7 miles long, which should be populated as rapidly as possible by some better system of rapid transit, which should also include the great suburban districts of Westchester County.

The dividing line of the up and down long distance travel is about 42nd St., and each day about 280,000 people are gathered from above that line and transferred to points below it, and taken back in the evening. After showing that but about 60% of those now traveling now have seats, Mr. CROES discussed methods of rapid transit, and claimed that there is a limitation to the use of present roadways, either 15 ft. above or below the street surface, as these were all intended and are urgently needed for other purposes. We could acquire a right of way either above or below this plane, but the speaker argued that it would be safer, more agreeable and more healthful to travel on top of this impermeable plane than below it in a close cavern. As cost is a prime factor, he believed it was cheaper to go overhead, even over private property; though Mr. CROES thought the extinguishment by purchase of the rights of abutting owners was much cheaper than the purchase of private property.

After discussing the difficulties to be met in underground construction, the speaker said that the lowest estimate for the extra work entailed by tunneling as compared with overhead construction, was $1,200,000 per mile for a 4-track road. Judging from the experience of the elevated roads in the lower part of the city Mr. CROES estimates the average damage to abutting property at $1,000,000 per mile; this added to the cost of tunneling as given above would provide $2,200,000 per mile for the purchase of right-of-way over private property in case this method were adopted. The temperature conditions were then discussed and the speaker believed that the effect of a tunnel would be very bad upon the health of travelers. He said that the city of New York can procure the money to extinguish abutting rights at a less cost than any corporation; and he thought that the advantages of a well planned, strong overhead rapid transit system would be apparent to all thoughtful men.

Mr. HENRY B. BEEKMAN favored an underground road for the reason that he believed that the difficulties attending the construction of an elevated road were substantially insuperable. He admitted that it was pleasanter to ride in daylight, but the element of land damage was one that could not be estimated in advance.

Mr. HENRY G. PROUT said that the system proposed by the Commissioners has been estimated to cost from $70,000,000 to $100,000,000. To earn 6% on the lowest estimated cost, the road must carry the same number of passengers traveling on the present elevated railways. To do this means doubling present traffic and competition with the elevated roads and all surface roads for short distance travel. He doubted if the proposed tunnel could be made sufficiently agreeable to travelers to attract this traffic. Ex-Mayor HEWITT and Mr. JOHN E. FITZGERALD followed with short addresses, the latter approving of underground plans.

THE TOPOGRAPHICAL SURVEY OF RHODE ISLAND is completed and a map issued on a scale of 1 mile to the inch with 20 ft. contour intervals. This map has been placed in all the schools and libraries and will soon be on sale at a slight advance on the cost of production.

The Comparative Merits of Various Systems of Car Lighting.

XII.

ELECTRIC LIGHTING (*Continued*).—THE COMBINED STORAGE BATTERY AND DYNAMO SYSTEM.

This system is in more extensive use for train electric lighting than all other electric systems combined. It is susceptible of much variation, according as the dynamo or the storage battery is made the prominent feature. At one extreme the storage battery is considered merely as an auxiliary to relieve the dynamo of excessive load and furnish light in case of stoppage. At the other the storage battery is the main feature and the dynamo is introduced to keep the battery charged and avoid the delay and the handling of the batteries at terminals, which we have seen to be chief objections to the storage battery system used alone. Another point of variation is in the disposition of the storage batteries, which are sometimes distributed to each car and arranged to keep the lights burning when the car is cut off from the train, and in other systems are all placed underneath the baggage car floor. Of course, this latter plan cuts off the light from the cars in case the train is broken, the same as the direct dynamo system; but the disadvantages which at present attend the use of storage batteries, such as fumes, decay of car timbers through leakage of acid, and necessity of frequent repairs are, of course, less important when the batteries are all in one place. The wiring is also simpler, cheaper, and perhaps less liable to derangement with the storage batteries close to the dynamo than when they are distributed through the train.

Another point in which systems differ is in the method of driving the dynamo. A favorite method abroad has been by a belt from a pulley on the car axle. This was tried on the Connecticut River R. R. by Mr. S. H. BARRETT; but it has never been used in this country to any extent. We believe, however, that the system of electric train lighting, on which the engineers of the Consolidated Car Heating Co. are now at work, will take power from the car axle to drive the dynamo, and will use storage batteries on each car.

ELECTRIC TRAIN LIGHTING IN ENGLAND.

The advantages of driving the dynamo from the car axle instead of by a separate engine are not a few. The heat, steam and vibration of the engine are avoided, the latter especially being sometimes quite serious. The space occupied by the engine is probably less than that by the belting connections from the car axle; and the system is claimed to be cheaper, both in first cost and cost of operation, than the system using a separate engine. The mechanical difficulties in devising an apparatus which will automatically connect and disconnect the dynamo as the train rises above or falls below the necessary limits of speed seem to have been successfully met

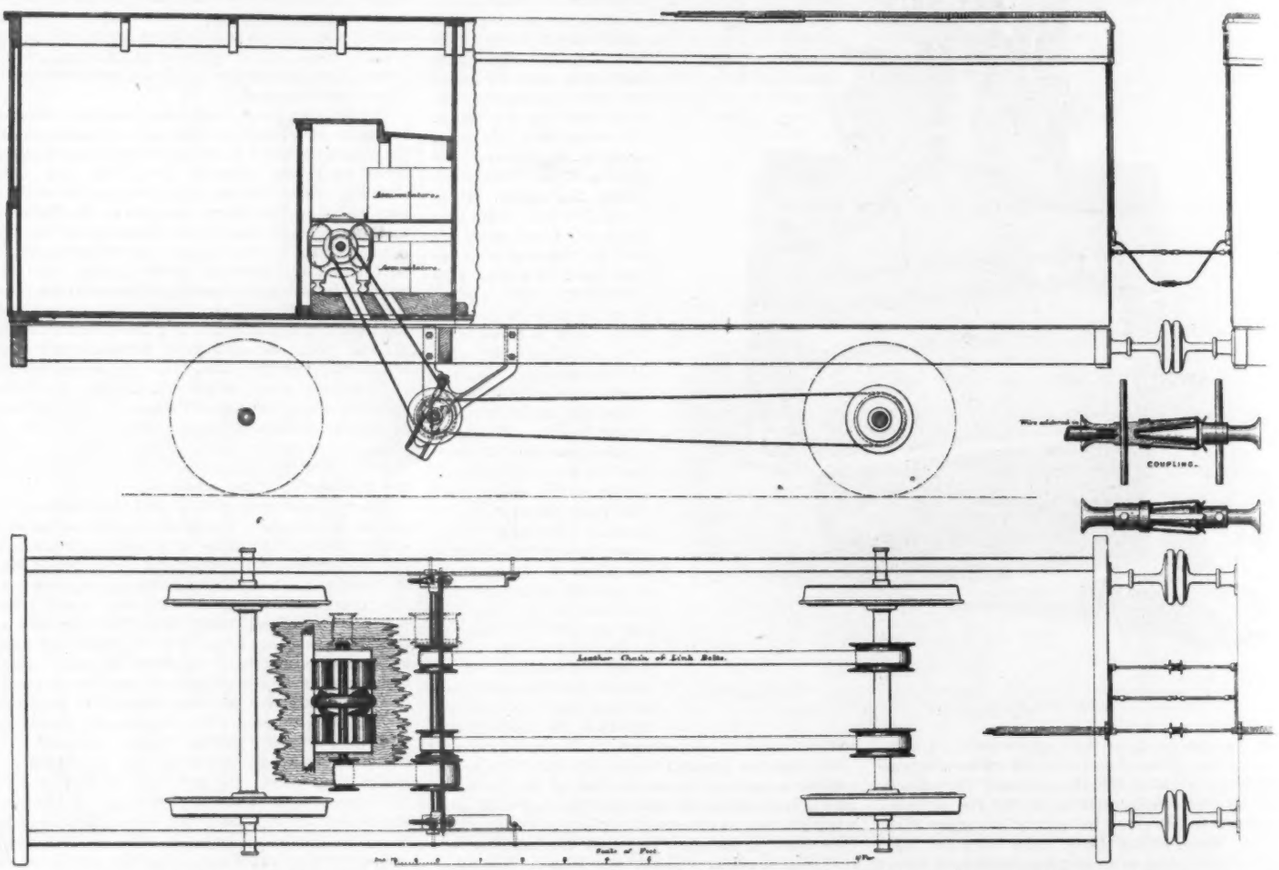


FIG. 1. METHOD OF DRIVING DYNAMO FOR TRAIN ELECTRIC LIGHTING FROM CAR AXLE IN USE ON LONDON, BRIGHTON & SOUTH COAST RY., ENGLAND.

dynamo from the car axle, which we reproduce herewith (Fig. 1). A great merit of this system from the economical point of view is the small attendance required. An inspection and oiling is made at the end of each trip, but no regular attendant is required on the train. The cost of skilled attendance is the largest item in the maintenance account of the American systems which use a special engine to drive the dynamo.

Notwithstanding the apparent success of this system of electric lighting, the managers of the London, Brighton & South Coast have recently determined to discard it and adopt the Pintsch gas-light system in its place. Whether it was the matter of expense, the inconvenience of not being able to split up trains without extinguishing the lamps, or some other reason that led to this decision, we are not informed.

The apparent success of this system on the London, Brighton & South Coast, however, has led to its adoption by several other British railway companies. The Great Northern began lighting a train with electricity on this system in July, 1886, and has 8 trains now running fitted with it. Two trains have been lit by this system on the Taff Vale lines and two others on the Cheshire lines. In all these cases the storage batteries are all located in the "guard's van," and the dynamo is also located there and is driven by belting from the car axle. The system is ther efore open to the same objections which we found inherent in the direct dynamo system. The train cannot be separated without extinguishing the lights.

To obviate this difficulty the Midland Ry. has modified the system by placing storage batteries on each car of the train, and has six trains now running equipped in this manner. This system was recently described at length by Mr. WM. LANGDON in a paper before the Institution of Civil Engineers. The main points of interest in the installation are as follows:

Both the "parallel" and the "series" system of

The London, Brighton & South Coast Ry., of England has had a long experience with this system, having used it since 1883. In the early part of the present year 16 trains were running on that road lit by electricity, and 6 more were being fitted. On the whole, electric lighting seems to have been effected there with as little inconvenience and at as moderate cost as on any railway in the world. The average train lit is 10 cars in length, and has 40 to 70 lamps of from 8 to 16 c. p. The dynamos have a maximum capacity of 5,000 watts (nearly 7 electrical HP.) The accumulators are all on the car which carries the dynamo, so that the train cannot be broken without extinguishing the lights.

The system as used on that road was the joint invention of Mr. HOUGHTON, electrician to the company, and the late WM. STROUDLEY, its mechanical superintendent. In a paper before the Institution of Civil Engineers in 1885, Mr. STROUDLEY described the general features of the system, and presented a drawing illustrating the apparatus for driving the

wiring have been tried; but the latter has been adopted as being manifestly the best, although it requires somewhat larger wire in the circuits. The first trains fitted had dynamos which gave a constant current output when a certain speed had been attained; but for later work a dynamo made by Holmes & Co., of Newcastle, which gives a current proportional to the resistance of the circuit and of constant electromotive force, has been employed. Carbon brushes are used on the dynamos, having been substituted with much advantage in place of the wire gauze ones formerly employed. They are placed radially to the commutators, the lead being automatically altered to suit the direction of rotation.

On the spindle carrying the armatures there is also arranged a reversing switch, actuated by friction disks which come into contact when the spindle slows down, but run free on its attaining any degree of speed. The duty of this reversing switch is to insure that the current shall always be in one direction, whichever way the vehicle is running.

Fig. 2, which we reproduce from the plates accompanying Mr. LANGDON'S paper, illustrates the

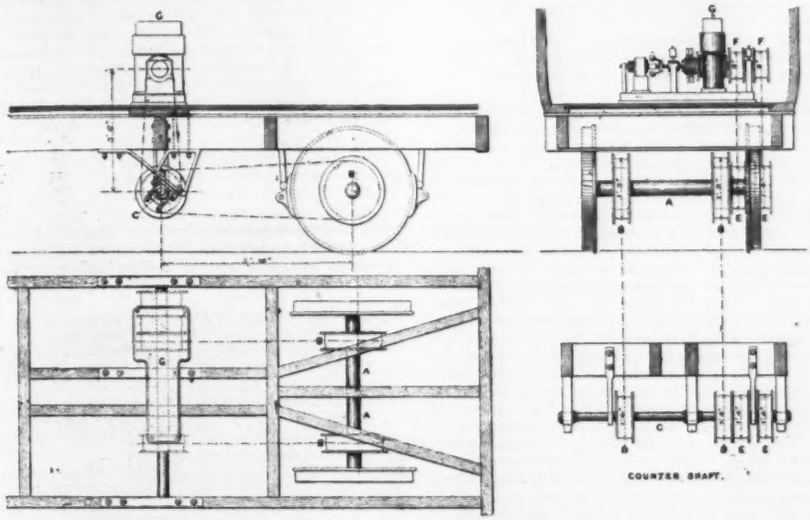


FIG. 2. METHOD OF DRIVING DYNAMO FROM CAR AXLE IN USE ON MIDLAND RY., ENGLAND.

method of driving the dynamo from the car axle. It will be noticed that the driving gear is double to prevent stoppage of the plant by mishaps to either belt. The pulleys on the axle are 21 ins. diameter; those on the countershaft are 16 ins. diameter, and the dynamo pulleys are 9 ins. diameter. It is not claimed that the arrangements shown are the most efficient that could be devised, as the proportions adopted were largely determined by the location of parts of the car gear which it was not desired to interfere with. The total weight of the dynamo with bed plate is 1,030 lbs., and the weight of the countershaft, pulleys, &c., is 1,456 lbs.

The storage batteries used are of the "E. P. S." type, supplied by the Electrical Construction Co. Where trains are not to be uncoupled the practice is to put the dynamo in the guard's compartment and the battery cells in an adjoining one. On main line trains each vehicle carries its own storage batteries, 18 cells being awarded to each, giving a current of 35 volts. Mr. LANGDON advises in arranging accumulators in the train, to set them so that the plates will be longitudinal with the train, to prevent them from breaking away from the shoulder piece to which they are attached. To avoid the possibility of an explosion from the accumulation of hydrogen there should be provision for good ventilation of the cells and of the place in which they are stored.

Where the accumulators are all in the guard's van the total weight of batteries used is 3,572 lbs. for one set of batteries or double this weight for two sets. Where accumulators are placed on each coach, the weight per vehicle is 1,000 lbs. for vans and coaches with seven compartments and 720 lbs. for coaches with six compartments. As to durability, the positive plates have lasted nearly two years, and some of them are now being replaced.

The electrical couplings on the Midland have been designed with much care to secure a coupling which can be easily and certainly made and which will provide good electrical connection. Indeed, Mr. LANGDON considers this one of the most important details of an electric train lighting system; and he believes that steps should be taken toward the adoption of a uniform design and location for such couplings.

Besides the six trains equipped with the system outlined above, the Midland Ry. has 4 trains fitted with different types of motor connected direct to the dynamo. These with the respective weights are as follows:

	Weight of:		
Motor and dynamo.	Combined apparatus.	Case.	Total.
Parson's electro-turbo generator	lbs. 1,064	lbs. 448	lbs. 1,512
Newall engine and Kapp dynamo	1,512	224	1,736
Brotherhood engine and Holmes dynamo	1,987	336	2,323
Rigg engine and Holmes dynamo	2,016	1,008	3,024

These dynamos and motors are set in their cases on the rear of the tender and take steam from the locomotive boiler, the steam supply being under the control of the engine driver. The entire apparatus is not touched from the beginning of the trip to the end, according to Mr. LANGDON. It is intended to make a careful comparison between the system of driving from the axle and driving by independent motor and determine which method gives the best results.

To care for the electrical apparatus on these ten electric lighted trains, a staff of six train attendants and a manager is provided. Two men are at the London terminus and four are at principal stations, where their duty is to inspect the apparatus on arriving trains, and if necessary ride through the next section and see that all is right.

In answer to the question whether the electric light is safe and reliable, Mr. LANGDON says that the electromotive force of the current employed (35 to 50 volts) is so low that a child could suffer no harm from it. There is no reason why the same safety which characterizes its use in stationary practice should not attend its use in lighting trains. The experience in train electric lighting, too, has now been extensive enough to make the fact that no casualties have thus far occurred from it one of some importance.

As to reliability, it is undeniable that failures have occurred; but Mr. LANGDON contends that they have in all cases been due to causes which can be traced and obviated. It is true that the lights are not as brilliant when operated by the battery alone as when the dynamo is at work, unless the capacity of the battery is unusually large; also that slight variations in the light may occur when the train travels at very high or very low speed (in the system taking power from the car axle). But unless the parts are improperly proportioned, there is no such variation as to interfere with the comfort of the passengers.

The total number of railway carriages now lit by electricity in England, according to Mr. LANGDON, is 365 coaches and 57 vans.

In the discussion on this paper it was pointed out that the use of electric light necessitated an additional coupling between the cars. Mr. W. F. PETTIGREW described experiments with a train of ten cars lit by 35 lamps, current being furnished from a rotary high speed engine and dynamo, mounted on the locomotive boiler. With this system, however, the equipment of seven locomotives was necessary in order to handle only four suburban trains, and this seems to be a marked disadvantage in placing the dynamo on the locomotive. Mr. W. H. PREECE alluded to experiments made by him in 1884 on the London & Southwestern Ry. A train was fitted with an air compressor driven from the car axle, and the compresed air was used to drive a small 3 cylinder engine which turned the dynamo and maintained the light when the train was standing still. The plan failed from its expense, and because every carriage had to contain the source of the light. At that time he had little faith in storage batteries; but now no electrical device is coming into use more rapidly, and he believed that in fourteen years there would be 100,000 railway carriages fitted with electric lights.

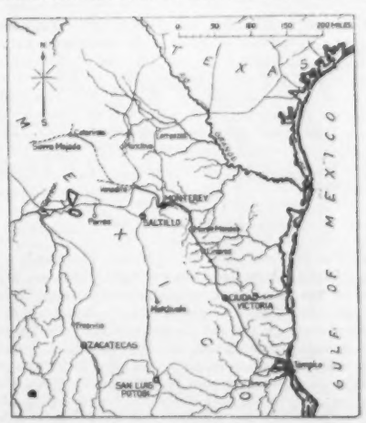
Mr. STEPHEN TERRY described a system of train lighting built by Messrs. Bumstead & Chandler and Crompton for use on the Government Railways of Cape Colony. The system is the "direct dynamo" without storage batteries (described last week). An independent boiler is used, furnishing steam to a tandem compound engine. The whole plant is placed in the guard's van, and exclusive of the boiler weighs only 1,210 lbs. Two trains lit by this system have been in use for about two years, and two more have just been put in service.

(To be continued.)

The Monterey & Mexican Gulf Railway.

We show in the accompanying cut a map of the Monterey & Mexican Gulf Railway, recently completed from Trevino to Tampico, Mexico, a distance of 393 miles. This railway is one of the most important constructed in Mexico for some years, both for its length and on account of its close connection with the railway system of the United States. We have abstracted the following details from the reports of CECIL GABBETT and EDWARD BATES DORSEY, who made a special examination of the line.

The company was chartered in 1888, and the road has been built under two concessions from the Mexi-



Map Showing Route of the Monterey & Mexican Gulf Railway.

can Government, one for the line from Trevino to Monterey, and the other for the line from Monterey to Tampico. The first section of 68 miles was opened for traffic in May, 1889, and the entire line was completed in July of the present year. The Mexican Government granted a subsidy of $8,000 per kilometre, or $14,220 per mile, Mexican money, and very liberal privileges in respect to traffic charges, freedom from duties, taxation, &c.

The route of the line is through the wide valley lying between the Sierra Madre and San Carlos

mountains, which is stated to be very fertile, and well adapted to the growing of all fruits and vegetables peculiar to this climate.

All material used in construction of the roadbed and track is of good quality. The track is standard gage, laid with 56-lb. steel rails fastened with double angle plates having four bolt holes. The ties are of southern pine and tropical hard wood, 8 ft. × 7 ins. × 8 ins., and are laid 2,640 to the mile. Nearly all of the switches are of the standard split type. About 40% of the track has been ballasted. The stations and other buildings are of wood or masonry, and are of a permanent character. The bridges are of wood with few exceptions. All water tanks are of iron upon masonry supports, with a capacity of 30,000 galls. each, and are all provided with steam pumps, and in many cases with windmills also. The shops of the company are located at Monterey. The motive power is of good quality. All locomotives have Westinghouse air pumps and American air brakes, and all passenger cars and about 100 box cars also have Westinghouse brakes.

It is proposed to build an extension from Trevino to Sierra Mojada, a distance of about 213 miles. This line would pass through a rich mineral and timber region, and it is estimated would cost about $2,600,000, or $9,727 per mile.

Work is now in progress on the jetties at Tampico, on the Gulf of Mexico, by which it is hoped to get a sufficient depth of water to admit of the passage of the largest vessels. This work is in charge of E. L. CORTHELL, assisted by Mr. WROTNOSKI, and reports of its progress have been published from time to time in ENGINEERING NEWS.

PERSONALS.

Mr. JOHN H. BROWN, President of the North Hudson Ry. Co., died at Weehawken, N. J., Nov. 17.

Mr. JOHN M. TURNER, Superintendent of the Louisiana Division of the Illinois Central R. R., has resigned.

Col. F. K. HAIN, General Manager of the Manhattan Elevated R. R., has been elected Second Vice-President of the company.

Mr. T. W. KENNEDY has been appointed Superintendent of the St. Louis & Hannibal R. R., vice Mr. GEO. B. CLASON, General Manager, resigned.

Mr. A. T. TOBIN has been appointed Chief Engineer of Bridges and Buildings of the Newport News & Mississippi Valley R. R. Mr. L. A. WASHINGTON has been appointed Roadmaster.

Mr. W. H. ARCHER, of Buffalo, N. Y., has been appointed architect of the Buffalo, Tonawanda & Niagara Falls electric railway, in course of construction, and has prepared plans of seven stations of that road.

Mr. JOHN H. TWEEDY, of Milwaukee, Wis., died Nov. 12. At a public meeting in Milwaukee on Feb. 1, 1849, Mr. TWEEDY presented the draft of a measure for the city to loan $100,000, to be increased to $250,000 if desired, to aid in the construction of a railway from Milwaukee to Waukesha, or to any railway which would connect Milwaukee with the Mississippi River. This proposition was adopted, and was the first step taken in the building of what is now the system of the Chicago, Milwaukee & St. Paul R. R.

NEW PUBLICATIONS.

—Modern Practice of the Electric Telegraph. A Technical Handbook for Electricians, Managers and Operators. By FRANKLIN LEONARD POPE, Past-Prest. Am. Inst. Elec. Engrs., &c., 14th edition, rewritten and enlarged. 8vo., pp. 234; 185 illustrations; 11 tables; $1.50.

This nominal new edition is in fact practically a new work, condensed by the omission of all matter in relation to certain special departments like automatic, stock and submarine telegraphy, and telegraph construction, but greatly enlarged in the departments of ordinary telegraphic work, to which it is now restricted. The progress of science in these departments has been so great that as a whole the enlargement from past editions is very considerable.

The general nature of the work still remains unchanged, however, and it has been so long and favorably known as to make it almost needless to say that it is perhaps the best manual which exists for the practical telegraph operator who wishes thoroughly to understand the work he is called upon to do, or for the engineer who wishes to study up the general theory and practice of electric telegraphy. The language is clear, plain and concise, to an even greater degree than heretofore, and typographically the book is quite a model of its kind, unless it be that the page is inconveniently large for the thickness of the book. An excellent feature is the addition of brief biographical notes in regard to the names which have become famous in electrical annals.

—Central Station Management and Finance. By HORATIO A. FOSTER, M. Am. Inst. Elec. Engrs., Special Census Agent for Central Stations. New York, C. C. Shelley; 8vo. pamphlet, pp. 50.

This is a reprint of a series of articles in the *Electrical Engineer*, devoted chiefly to the practical details of central station bookkeeping and accounting, with numerous complete reprints of the forms used, as devised by the author, all of which are for sale by the publisher. They seem well adapted for their purpose, and the descriptive matter is practical and to the point.

—Sixth Annual Report of the Commissioner of Labor, 1890. Part 2. Cost of Production, Iron, Steel, Coal, &c., CARROLL D. WRIGHT, Commissioner, Pub. doc., 8vo., pp. 601.

This report is the result of immense labor and sets forth the facts within its range of inquiry with great detail and almost absolute completeness. The facts given are deduced from actual copies of the pay rolls for a year (in most cases) of 99 establishments in the northern and southern United States, Great Britain and the Continent. It is needless to say that these establishments are indicated only by numbers, but for each one of them, and for every separate grade and class of employes in it, are given the average daily pay, the number of men in the grade (which will not average more than 2 or 3, so close is the subdivision), the actual number of days worked, yearly earnings per man and *possible* yearly earnings if working full time, the possible and the actual differing very materially.

To do this takes 470 pages, and then follows a tremendous "summary" (able of about 100 small type pages where all the different rates of pay for each class of workmen are listed together in alphabetical order. There must be 700 to 800 different kinds of labor thus classified, and we may remark in passing that the instances where so much as $3 per day is paid even to foremen are few and far between. As a rule, labor in the iron trades seems to be rather poorly paid, though much better paid here than abroad.

Then follow some comparatively small but very interesting tables of the comparative efficiency of labor, in terms of the output in tons per man per hour and earnings per hour. This efficiency is also shown for each of the 99 establishments listed separately. The pith of the whole investigation for the general reader, who is not studying how to improve some particular work but only to know the final comparative result without detail, is given on the very last page of the volume, where "the efficiency of labor by industries" is abstracted. This is such an interesting table, and so unusually accurate and trustworthy, that we have separately abstracted its substance on an editorial page. From one point of view it almost seems a waste of space to give so much of the preliminary details when the conclusions of most general interest can be shown on a page, but it must not be forgotten that a leading purpose of all such investigations is to improve our own industries by revealing defects or excellences of detail, and for this end elaboration is essential.

Our government does a great deal of splendid work of this character, more, perhaps, than any other in the world, but it has rarely done better work than in this report.

TRADE PUBLICATIONS.

—Priestman Standard Oil Engine. Priestman & Co., Philadelphia, Pa. Paper, 6¼ × 3½ ins., pp. 8.

This pamphlet is descriptive of the Priestman petroleum engine, which is already in extensive use abroad, and was described and illustrated in ENGINEERING NEWS, Nov. 17, 1888.

SOCIETY PROCEEDINGS.

American Society of Mechanical Engineers.—The annual meeting was held at New York, Nov. 16—20, the number of members in attendance being very large, upward of 450 persons (including some 100 ladies) having attended.

As a consequence even the good sized hall of the society house was quite too small for the opening exercises on Monday evening when President R. W. Hunt delivered the annual presidential address, followed by a conversazione and collation. Sherry's new assembly room, Fifth Ave. and Thirty-seventh St., was therefore engaged for that purpose. The admirable address of the President, which was a résumé of rolling mill progress in America, is given in part in another column, and will be concluded in our next issue.

Tuesday morning the business session was held. The report of the Secretary was in substance as follows: The Council had held 9 meetings during the year. Public libraries which applied were being supplied free with the current publications and even with back volumes. The informal social reunions managed and paid for by the local members, and at which ladies attend, had been a pronounced success. The first was made the occasion for unveiling a portrait of Holley, and the last of Worthington. Intermediate meetings had had for the subject of addresses: Robert Fulton; Growth of the Railway; Egypt New and Old; Electricity Previous to Galvani. Prof. Thos. Eggleston had given to the society a handsome colonial mahogany dining table, formerly the property of Robert Fulton.

The society library fund had received a gift of $513 from the Providence local committee, the excess of its receipts over the expenses at the late Providence meeting. At the request of the mechanical engineer of the Columbian Exposition a committee had been appointed to formulate a series of engineering tests to be made in the exhibits. The committee was awaiting assurance that there could be no future conflict of jurisdiction with the Award committees before proceeding further. The Council had undertaken revision of the rules by raising dues and the circulars of inquiry issued by them had elicited an all but unanimous expression in favor of the increase. [The last was brought out more definitely later in the form of a pile of postal cards 8 to 9 ins. high in favor, and less than ½ in. against the increase, which, as has been heretofore noted in these columns, is $5 per year increase all around, and $10 more on members entrance fees, making it $25.]

The invitation to hold the opening meeting in San Francisco had been accepted, 723 out of 796 responses being in favor of it, and only 73 against.

The Council also felt it time to initiate action toward inviting the Institution of Civil Engineers and Société des Ingenieurs Civiles to visit America in 1893, and had proposed to the other three national societies that a committee of 3 ex-presidents (or vice-presidents) be appointed by each, making a joint committee of 12. The question of an engineering headquarters and congress at Chicago was also under consideration. During the year, 323 applications had been approved; 9 members had died; the present membership was:

	1891.	1890.
Honorary members	18	18
Members (13 and 10 Life)	1,203	1,025
Associates	56	52
Juniors	166	117
Total	1,443	1,220

The tellers then reported that 65 new Members, 4 Associates and 34 Juniors were found elected on the the pending ballot. We regret that the burden of publishing these long lists is becoming too great for us to give the space to them.

The Finance Committee reported as follows:

Receipts.		Expenses.	
Entrance fees	$3,180	Printing, &c.	$2,418
Dues, current	11,738	Publications	3,090
" past	110	Postage	1,121
" advance	70	Library	64
Sales transactions	1,625	Salari's	4,152
" badges	996	Office exp.	630
" binding	776	Engraving	1,825
" engravings	343	Binding	844
Rent hall and parlor	425	Meetings	885
Life memberships	500	Furniture, &c.	621
Furniture	28	Badges	707
Interest	73	Traveling	121
Balance	35	Rent	2,200
		Holley meeting	212
		Committees	37
		Sinking fund	809
		Sundries	107
	$19,843		$19,843

The deposit to credit of library fund is $2,273. On the other hand there are pending bills for the current volume of transactions, &c., of $3,585.15. There is due from over 1,300 members only $129.90 from 11 delinquents. The plan of drawing on members 12 mos. in arrears has proved satisfactory.

The Library and House Committee show the following balance sheet:

Receipts.		Expenses.	
Fellowship	$349	Interest on m'tg'e	$1,485
Sinking Fund	1,96	" " bonds	1,635
Library { perm't	538	Salaries	490
Library { current	576	Supplies	84
Rent office	2,677	Fuel	166
" rooms	996	Lighting	419
Sundries	34	Equipment	686
Bonds	1,400	Laundry	199
Balance	23	Insurance, taxes	78
		Binding	158
		Repairs	147
		Bonds	1,100
		Bills payable	1,000
		Balance	902
	$8,549		$8,549

The Committee on Standard Methods of Testing Materials reported in substance that they had completed their work as to commercial testing, and were now at work on methods for scientific tests. Mr. G. C. Henning, of the committee, had agreed to attend the coming conference at Vienna relative to uniform methods of procedure in testing building and structural materials, to be held in September, 1892, if some allowance were made toward his expenses. It is expected the Council will make such allowance.

The Committee on Standard Diameter of Flanges reported progress. The Steam Fitters' Association committee was ready to co-operate. The general idea was three standards for high, medium and low pressures, fixing exterior diameters, diameter of bolt holes and number of bolts.

The Committee on Standard Methods for Testing Locomotive efficiency, of which Mr. Wm. Forsyth (C., B. & Q.) is chairman, merely reported progress.

The tellers reported 558 ballots cast for officers, of which 21 were irregular. The ballots were all for the regular

ticket, headed by Chief Engineer Chas. H. Loring, U. S. A., for president, with 4 to 8 scattering votes. Messrs. Geo. I. Alden, E. F. C. Davis and I. M. Scott were elected vice-presidents, and Messrs. Jas. M. Dodge, W. Robert Forsyth and Jesse M. Smith, managers.

The afternoon was devoted to excursions according to individual preference. A new and useful device in regard to these was used; 16 different and numbered cards were placed in as many boxes stating exactly what was to be seen and how to see it. Members were then left to go separately or collectively as they preferred.

In the evening papers by Messrs. Nagle, Main and McElroy were read. Most of the papers read at the meeting are separately abstracted in another column, or will be in our next following issue. In addition to the papers which we thus abstract, there was a long and careful historical paper by Mr. Samuel McElroy on "The Brooklyn Pumping Engines of 1860," which practically constituted a history of pumping engine practice in the United States and England up to and including 1860, and as such is hardly capable of much condensation, while we cannot give space for a reprint. Mr. A. F. Nagle had two papers, one on "Experiments to Determine the Rate of Rise or Fall of a Mercurial Thermometer Under Different Conditions," showing of course that the difference is great whether the air be still or in motion, or the temperature rising or falling, &c., and closing with some suggestions as to proper modes of making sprinkler text. The other paper by Mr. Nagle, "Limitations of Steam Engine Economy," had altogether too broad a title for its tests. It gave simply the theoretical amount of steam per horse power for an engine having no clearance or waste space or *any* cylinder condensation, "submitted for the study of such as have not already the information," and hence would hardly seem to require abstract (not to say publication) in its present form. It strikes us that such a paper should either be fully worked out to cover the more ordinary and inevitable conditions of practice at least, or not begun.

Wednesday, Nov. 18, was devoted to an excursion to the Navy Yard and the De La Vergne Refrigerating Co. at East 138th St., luncheon being served on board the boat, the trip occupying from 10 to 4. A theatre party tendered by the New York members to the non-residents occupied the evening.

Thursday A. M., Nov. 19, was devoted to the reading and discussion of papers as elsewhere abstracted, the afternoon to individual excursions, and the evening to a very successful and largely attended reception at the new Lenox Lyceum, followed by dancing at about 11 P. M.

The morning of Friday, Nov. 20, was devoted to a brief and less numerously attended session, at which the concluding papers were read and a topical discussion of suggested questions held. The meeting as a whole was one of the most successful which the society has held, though the list of papers was not so long as it has been at many prior meetings, and no committee reports of any technical importance were submitted.

New England Railroad Club.—At the regular meeting on Nov. 11 an amendment to the by-laws was adopted fixing the dates for the regular meetings on the second Wednesday of every other month, beginning in January, 1892; provided that the meeting in July may be omitted by vote of the club. The subject discussed was "Care of Steam-Heated Cars at Terminal Points," opened by Mr. J. N. Lauder, who said that continuous heating of railway trains by steam from the locomotive has undoubtedly come to stay. The matter of heating the trains while on the road by any of the existing systems has come to be a comparatively simple matter. The greatest difficulty at present is in the care of cars at terminal points when standing in car houses or on sidings outside.

The Old Colony R.R. began two years ago to take care of steam heated cars on one division by the use of stationary boilers at the most important points, and with old locomotives and road locomotives at other points. At Boston steam pipes were laid underground all through the car yard, in wooden boxes 8 ins. square inside, made of 2-in. plank, the space around the pipe being filled with non-conducting material. This worked well until one morning a heavy rain storm and high tide coming together submerged the whole yard under two or three inches of water, and of course no steam could be got through the pipes. This underground system was torn out last Spring and a new system was put in with all pipes above ground, pitched uniformly toward the farthest point at which steam is used. This system gives dry and hot steam at any point, and much better results on the whole than the other system tried. Of course in some cases pipes must be run underground.

The Old Colony labors under peculiar difficulties in this matter, the system being made up of a large number of short branches. There are no less than 41 different points where passenger cars lie during the night and have to be made ready for service in the morning. At some points the cars may be allowed to cool off if they are heated with direct steam, the couplings being disconnected and the dripcocks opened so that all water will drain off. In the morning the locomotive can be got out an hour before the train starts to warm up the cars. If the cars are heated with hot water, however, they must be kept warm during the night to prevent freezing up. As to the amount of steam it takes to do the work, no one can tell anything about that except by actual tests. Two 54-in upright boilers were put in at Dedham two years ago to keep the cars warm overnight, but a locomotive had to be used in addition, and finally two more boilers were added. The plant has to keep 65 to 75 cars warm from midnight to 5 A. M. Two years ago Mr. Lauder estimated that it would cost $198,000 to get the Old Colony cars ready to be heated by steam, and that 76 men would be permanently added to the pay roll, at an average rate of $2 per day.

He considered it necessary to have every locomotive on the road equipped both front and back for steam heating, in order to make the system entirely available for passenger service; for any locomotive is liable in an emergency to be attached to a passenger train.

Mr. Marden said the Fitchburg had 22 or 23 points where passenger cars lie over night. At Boston and Troy the cars are taken care of by stationary plants; elsewhere by locomotives, and no serious trouble is found in doing this. At Boston the steam pipes are in boxes about 6 ins. under ground. He had been from the first a strong advocate of direct steam on account of the necessity of keeping warm the cars fitted with hot water systems. During last winter the Fitchburg had but one car with frozen heating pipes. At some points on the road the direct steam heated cars are attached to the train cold, but they warm up rapidly and the passengers do not seem to be much troubled.

The question of joint inspection was here taken up. Messrs. Adams and Chamberlain spoke against the system. The former did not believe it could be made a success. The Boston & Albany had tried it for a year and abandoned it. Mr. Chamberlain has joint inspection at three places, at Ayre Junction, with the Fitchburg, and with the Concord & Montreal R. R., and it works very well. He is yet to be convinced, however, that joint inspection is desirable. Mr. Marden agreed with Mr. Adams that it was too much to expect that a joint inspector would serve both parties alike. He had tried to believe that joint inspection was the most economical plan, but he had not yet been able to convince himself of that fact. He believed heartily in uniform inspection, however, and would favor anything which would bring it about.

Mr. Angus Sinclair had advocated joint inspection; but found to his surprise that while the big roads were highly satisfied with it, the smaller roads held that they were in the position of the lamb who lay down with the lion—on the inside. Mr. Lauder was willing to put himself on record as opposed to any system of joint inspection. He didn't believe in anything joint, but thought each road should manage its own business.

At the meeting on Dec. 9 the subject discussed will be "Tools and Machinery for Railway Shops."

Engineers' Club of Philadelphia.—Meeting of Nov. 7. President Wilfred Lewis in the chair and 50 members and 5 visitors present. Mr. Max Livingston read a paper on "Some Comparisons as to the Relative Value of Solid, Liquid and Gaseous Fuels," which was discussed by Messrs. Christie, Carl Hering, H G. Morris and T. C. Smith. Mr. W. W. Thayer presented a paper on "Street Paving," which brought out a lengthy discussion from Messrs. Samuel, Rudolph Hering, James Cristie and Bullock.

Mr. Hering disagreed with the author in his remarks upon crowning the surface. He said the steepness of this crowning should be proportioned to the roughness and porosity of the material used. European stone blocks are much more accurately dressed than in this country. He did not believe in covering Belgian block with sand after it is rammed and pitched; this is a relic of cobblestone paving and is not done in Europe; the sand soon washes away at best. In Europe, where rock asphalt pavements are kept scrupulously clean, it is not more slippery than granite; changes in temperature do not affect rock asphalt pavements in London, Paris and Berlin as they do Trinidad pavement here. The rock asphalt pavement was down on Cheapside, London, for 11 years and gave excellent satisfaction under perhaps the heaviest traffic in the world. Sand is strewn upon asphalt and wooden pavements where the grade exceeds 2%, but not on level stretches. As to wood pavements those dismissed by the author of the paper as quite worthless are the ones that have achieved the greatest popularity in London and Paris in the last 10 years. In Europe the blocks are creosoted before laying and great care is given to the foundations, repairs are also carefully and constantly made. Norway pine is largely used for blocks in Europe.

Mr. Bullock, in commenting on the paper, said that in an asphalt pavement which gave trouble in Philadelphia, the coating of asphalt was too thick and "shoved" in hot weather; there was no bond between the Trinidad asphalt and the concrete base. In relaying this pavement he used the "vulcanite base and binder," a concrete made of small stones and No. 4 coal tar, without cement. When taken up the top of the foundation comes with this coating. Mr. Bullock said that as regards traffic 8,000 lbs. is a common load for two horses, with 2½ to 3-in. wheels; our present roads will not bear this traffic.

At the next meeting of Nov. 21, Mr. R. W. Lesley will read a paper on "Purchasing Cement for Large Works." He will advocate purchasing cement for its mortar-giving qualities rather than on its neat 7-day test, and consequently compelling manufacturers to grind the cement finer. A paper will also be presented by Mr. Pierre Giron on "The Portland Cement Industry in Europe and America." The present annual output of Portland cement in Europe is over 20,000,000 barrels; of which England produces 8,300,000 barrels; Germany about the same; France 1,800,000 barrels; Russia, 900,000 barrels; Belgium, 800,000 barrels; Norway, 800,000 barrels; and the United States now makes over 3,000,000 barrels per year. The American system of manufacture is similar to that of Germany. By the new processes used at Coplay, Pa., this cement is guaranteed to stand 400 lbs. in seven days, 500 lbs. in a month, and 600 in three months, and to not leave more than 10% residue in a No. 80 sieve.

Institution of Mechanical Engineers (England).—At the meeting of Oct. 28-9 two papers were read: "Some Details in the Construction of Modern Lancashire Boilers," by Samuel Boswell, of Manchester; and the report to the Research Committee on Alloys was made by W. C. Roberts Austin, F. R. S. The latter serves merely as an introduction to the work that is to be performed by the Research Committee and is of a purely scientific nature. The greater part of it is taken up by drawing analogies between the action of alloys on gold, and from these premises arguing as to their probable effect on baser metals, which, however, are more complete in their molecular structure. Mr. Boswell's paper was of a "shop-practice" nature. The author has had great practical experience in boiler making, being formerly employed by the London & Northwestern Ry., but now connected with the great boiler making firm of Galloway, at Manchester. Mild steel he takes as the one proper material from which to construct boilers, and he points out how much advance has been made in the production of this metal within the last few years. This is illustrated by the thinning of corners, which can now be done in the fire instead of by the planing machine. He quotes experiments to show that the plate can be locally heated in this way and would not require subsequent annealing.

In the matter of drilling there is not much to say which is not now recognized practice. In all the best boiler shops plates are drilled in position, the accuracy of the work being immensely improved thereby, in addition to which bending to a true curve is difficult after rows of holes have been made. Mr. Boswell was very frank in acknowledging the use of the drift for bringing plates together. The drift has got such a bad name that boiler makers have endeavored to repudiate its use *in toto*. In this they have been somewhat disingenuous, for drifts are largely used, even in the best works. If holes are drilled true, no harm will be done by the drift.

The respective values of gusset stays and bolt stays were discussed, and a useful hint was given as to the way the former should radiate without getting a nip where the stay passes from between the supporting angles. The tendency was to condemn bolt stays, or at any rate to do away with them as far as possible. The question of testing gave rise to some discussion; the new admiralty regulations, in which a constant is used in place of the test-pressure, appear to be growing in favor, to judge by the discussion. A somewhat tame meeting was brought to a conclusion by the usual votes of thanks.

Liverpool Engineering Society.—At the first ordinary meeting of the eighteenth session, held Oct. 28, Mr. John T. Woods delivered his address as President, taking for his subject the collection and disposal of sewage and the pollution of rivers. He stated that the question of sewage disposal broadly lay between irrigation and precipitation with filtration, and the first essential condition of a perfect system of sewerage for any center of population was that the sewage should be collected in practically water tight sewers and drains, so designed as to size and grades that, being self-cleansing, they would admit of its speedy removal to some convenient place for treatment. He then proceeded to point out the difficulties that lay in the path of the sanitary engineer who had advised the treatment of a certain sewage by broad irrigation, not the least of which, he said, was the difficulty of obtaining a sufficiently large area of land of a suitable quality in such a position and at such a price that the local authority would be justified in acquiring it. He dealt with the various characters of the evils met with, and their advantages in producing good results both in the shape of effluents and crops, and discussed the question of the under-drainage of irrigation areas, and the objections taken to such areas on the plea of nuisance to the surrounding inhabitants, together with the quantity of land required in various cases. He also gave estimates showing the first cost and the annual cost of maintenance of a farm where the sewage was treated entirely upon the land, and of a similar farm where precipitation was first employed and the sewage afterward filtered through a much smaller area of land. From these estimates, he said, it appeared that alike on the merits of purification and on the basis of annual cost, broad irrigation, when it is possible to conduct it under fairly good conditions, is the preferable system. In conclusion he made some remarks upon electrical processes of purification.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.
Entered at the Post Office, New York City, as Second Class Matter.

Vol. XXVI. Saturday, Nov. 21, 1891.

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Subscription Rates: *One Year,* **$5.00;** *6 months,* **$2.50;** *4 months,* **$2.00;** *Single Copies, 15 cents. To all* **Foreign Countries** *in the Postal Union, add $2.08 to above prices for postage. Subscribers can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses.*

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COMING TECHNICAL MEETINGS.

Montana Society of Civil Engineers.—Nov. 21. Helena.
Western Society of Engineers.—Dec. 1. Secy., J. W. Weston, 280 La Salle St., Chicago.
Engineers' Club of St. Louis.—Dec. 2. Secy., Arthur Thatcher, Room 801, Odd Fellows' Building.
American Society of Civil Engineers.—Dec. 2. Secy., Francis Collingwood, 127 East 23d St., New York.
Engineers' Club of Minneapolis.—Dec. 3. Rooms, Public Library Bldg. Secy., F. W. Cappelen.
Association of Civil Engineers of Dallas.—Dec. 4. Secy., E. K. Smoot, 803 Commerce St.
Technical Society of the Pacific Coast.—Dec. 4. Secy., O. von Geldern, 819 Market St., San Francisco.
Swedish Engineers' Club.—Dec. 5. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
Northwest Railroad Club.—Dec. 5. Rooms, Union Station, St. Paul.
Civil Engineers' Society of St. Paul.—Dec. 7. Secy., C. L. Annan.
Engineers' Club of Kansas City.—Dec. 7. Rooms, Baird Building. Secy., H. Goldmark.
Atlanta Society of Civil Engineers.—Dec. 8. Secy., Parker N. Black, Room 39, Capitol Block.
Denver Society of Civil Engineers.—Dec. 8. Secy., Geo. H. Angell.
Northwestern Society of Engineers.—Dec. 8. Rooms, Occidental Block, Seattle. Secy., E. H. Warner.
Civil Engineers' Association of Kansas.—Dec. 9. Secy., J. C. Herring, Wichita, Kan.
New England Railroad Club.—Next meeting, Dec. 9. At United States Hotel, Boston. Secy., F. M. Curtis.
Civil Engineers' Club of Cleveland.—Dec. 11. Secy., A. H. Porter, 50 Euclid Ave.
Engineering Association of the Southwest.—Dec. 11. Secy., O. H. Landreth, Nashville, Tenn.
Northwestern Track and Bridge Association.—Dec. 11. Rooms, Union Station, St. Paul.
Western Railway Club.—Dec. 15. Rooms, Rookery Building, Chicago.
Engineers' Society of Western Pennsylvania.—Dec. 15. Secy., J. H. Hariow, Pittsburg, Pa.
Boston Society of Civil Engineers.—Dec. 16. Secy., S. E. Tinkham, City Hall.
Engineers' Club of Cincinnati.—Dec. 17. Secy., J. F. Wilson.
New York Railroad Club.—Dec. 17. Rooms, Gilsey House.
Scandinavian Engineering Society of Chicago.—Dec. 17. Secy., T. G. Pihlfeldt, 118 Adams St.
Southern and Southwestern Railway Club.—Dec. 17. Secy., W. H. Marshall.

THE partition of the African continent among the principal European nations is a matter of such recent history that the map in another column showing the "spheres of influence" of each nation will doubtless be a revelation to most of our readers. One cannot examine this map without being struck by the manner in which history repeats itself. Just as diplomatists at European capitals have during the past few years been fixing the metes and bounds of each nation's territory in the Dark Continent, so two or three centuries ago the nations of Europe divided up North America, fixing the boundaries of each other's territory by lines more vaguely defined than those which limit the boundaries of European divisions in the Sahara and Soudan. The world moves, however; and whereas many long and bloody wars were fought for the possession of American territory, the partition of Africa has been accomplished by peaceful negotiation. Another contrast is the time required. Nearly three centuries passed by while the political boundaries in North America were being permanently defined. In Africa, notwithstanding its inhospitable climate, nearly as much has been accomplished in a decade.

The map showing the relative value of African lands will also be of interest to many engineers who are thinking of trying their fortunes in Africa. There is doubtless a great field for commercial enterprise in that continent, and it is already being improved by many European companies. Whether any better opportunities exist there than are to be found in the tropical countries of America, may well be doubted. Either locality is apt to prove the poorest refuge in the world to engineers whose only capital is their ability; and it is only as capital is attracted to the development of these localities that engineers will find it advantageous to seek their fortunes there.

WE observe in the last catalogue of the Michigan Mining School what we should be glad to see in all college catalogues, a detailed table of the total number of hours per week for each week in the four-year course (as it is to be hereafter) which is devoted to each separate study, with the instructor in that department. From such a list whoever cares to do so can determine with much precision the general character of the instruction offered, as he cannot do at all from a mere list of the several subjects studied in each term, which there is a constant temptation to spread out as thin as possible so as to appear to cover a great deal of ground. We have had the curiosity to condense the schedule of the Michigan Mining School, with the following result:

	Hours in entire course.	Per cent. of entire course.
Chemistry, assaying, etc	1,168	18.7
Metallurgy, mineralogy, crystallography, etc	994	16.0
Mines and mining, surveying, engineering and ore dressing	616	9.9
Geology (322 hours field)	518	8.3
Shop practice, etc	728	11.7
Drawing and designing	560	9.0
Surveying	462	7.4
Total, relating directly and immediately to the practical work of a mining engineer	5,046	81.0
Mathematics (168 calculus, 42 graphics, 42 hydraulics)	478	7.7
Properties of materials, mechanical and structural engineering	350	5.6
Physics	174	2.8
Electrical engineering	182	2.9
Total, relating to general theory and incidental features of mining practice	1,184	19 0
Grand total of course	6,230	100.0

The classification of the separate items is necessarily a matter of opinion, more or less, and necessarily somewhat arbitrary. For example, electrical engineering is coming to have a far more "direct and immediate" relation to the practical work of the mining engineer than geological studies, and it is probable that the proportion of the time allotted to electricity will soon be much greater than above in this and all other schools. But whether anyone likes the classification or not, or likes the apportionment of time or not, there it is for anyone concerned to deduce for himself exactly what the college has to offer him and what he may expect to bring away from it. It is evident at once, for example, that the course is strictly utilitarian and in that sense one-sided. There is no time wasted on "the humanities" or *belles lettres.* The same is true of most of our high grade technical schools, and very naturally. Whether this is in the end for the best good of the students, even as respects mere material success, we must confess we have our doubts.

WHETHER or not it be possible to usefully test cement by the quick process of microscopic examination is a subject which is at least worthy of consideration, and certainly a record of microscopic tests of a series of cement which have likewise been very exhaustively tested by the ordinary process, has especial interest. It appears to us reasonable that the microscope should at least afford a useful and ready check upon certain classes of defects which afflict cement, like under or over burning or lack of homogeneousness. We therefore publish in this issue two papers, both relating to careful tests of the same brands of cement, in the one case by the old and well tried process of making and breaking briquettes, and in the other by the quicker process of the microscope. The two together will enable any one who chooses carefully to compare the two, and in that way obtain a much clearer idea of the possibilities of the microscopic test than would be otherwise possible.

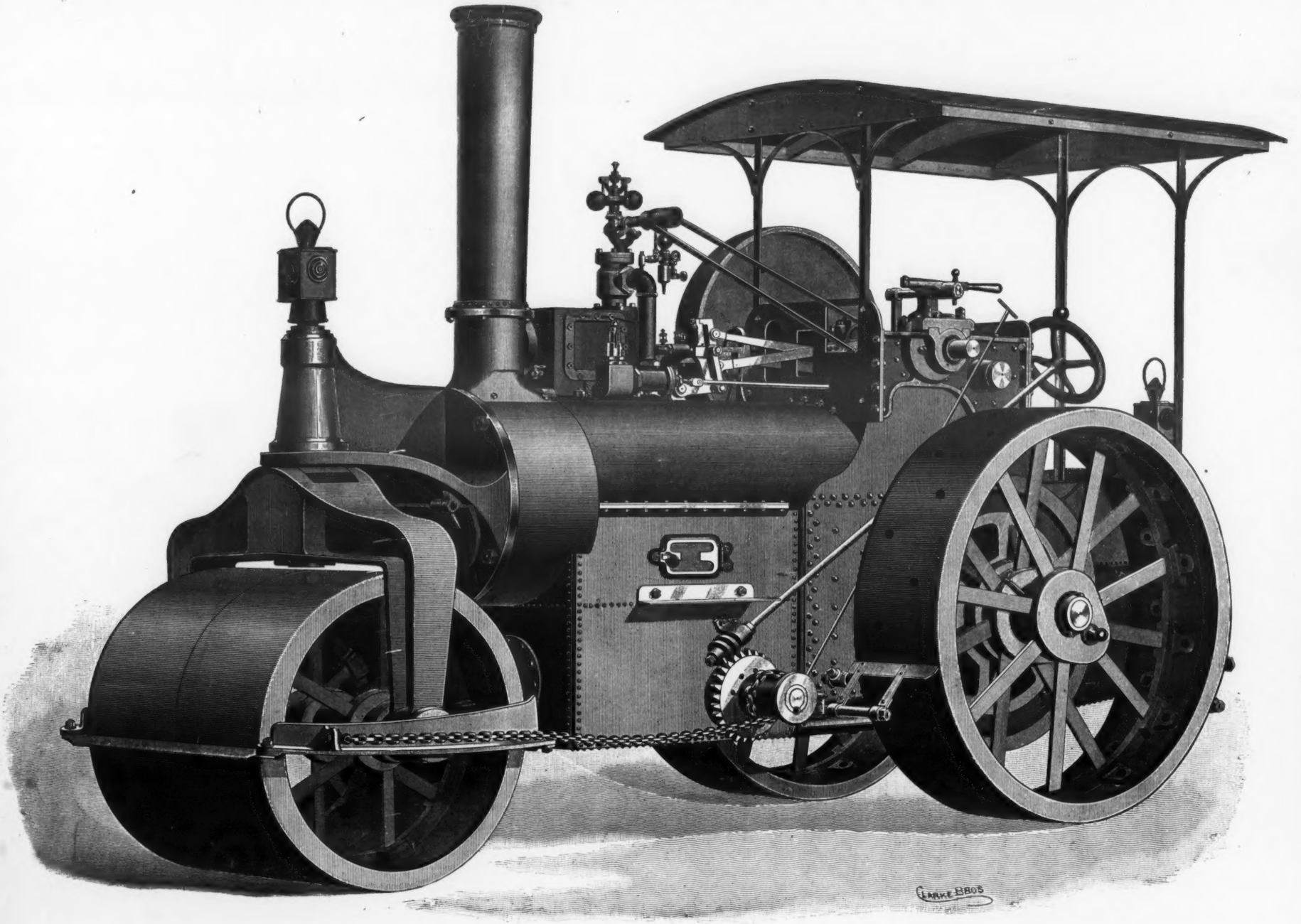
It is also worthy of note that these two papers are both examples of careful and excellent under-graduate work, as will appear in another issue. All three of these papers appeared in the same issue of *The Transit*, the University of Iowa journal, and give strong evidence of good work done in the classes of that institution, as the latter are still small. We may add that the publications of a number of the other engineering schools are steadily rising in value and are now among our most valued exchanges. We frequently find in them papers of great merit relating to experimental or other investigations which have been carried on by undergraduates; affording strong evidence that the instruction offered in our leading engineering schools, and some of the smaller ones as well, is steadily improving and is now of a high grade.

THE comparative inefficiency and extravagance of our city administration is so old and trite a subject of complaint that it seems almost superfluous to call attention to any new evidences of it, and yet the details given in another column, of the way in which European cities manage their street railways, are in such striking contrast to our "go as you please" ways in regard to street railways, that we cannot refrain from calling especial attention to them. Speaking in the large, and ignoring a very few exceptions, there are these radical differences between American and European street railway practice, in all of which the public interests are more carefully guarded there than here:

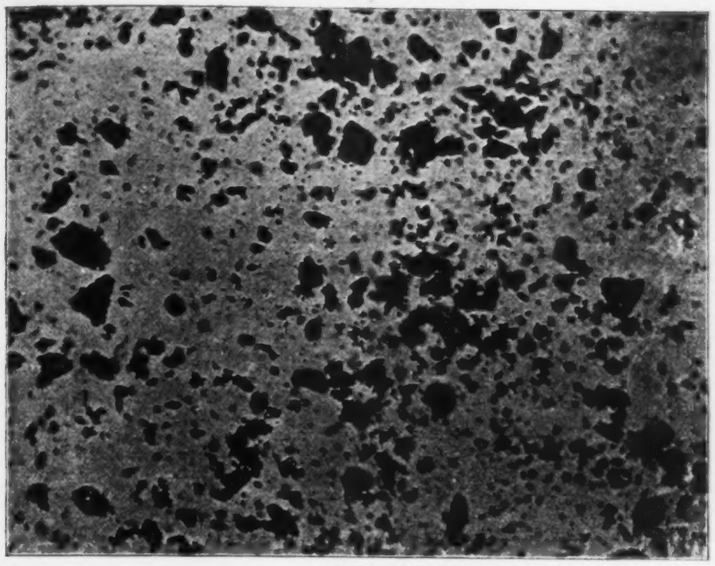
In the first place, with a few minor exceptions, no public vehicles whatever in Europe are allowed to carry more passengers than they can seat. As a consequence, a sufficient number of vehicles are always provided, even on lines of extremely heavy traffic. Here, there is no such restriction, and as a consequence even our lines of thin traffic show unblushing effrontery in running only cars enough to carry the passengers standing. This practice is so nearly universal that most Americans have become reconciled to it as a necessary evil, whereas, in fact, in most if not all cases, it is merely due to an utter lack of public checks upon private greed.

Secondly, all European street railways are compelled to use a rail which does not injure the street for the use of ordinary vehicles. Here it is notorious that most of our street railways have been permitted to choose and lay down a rail expressly designed to make the street as uncomfortable as possible for vehicles, and only recently has there been any discoverable tendency to abatement of this nuisance.

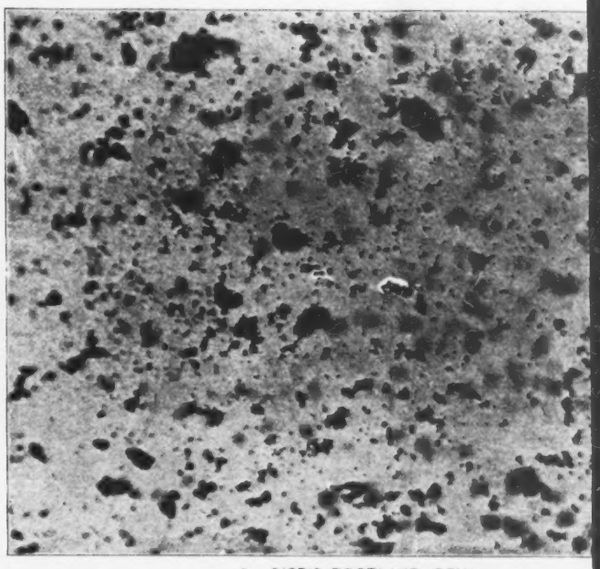
Thirdly, nearly all European street railway companies make much heavier payments to cities in return for their privileges than are customary here, while yet they charge lower average fares and are held up to a higher standard in regard to the maintenance of pavements and other matters of that nature. And yet the European street railway systems are generally of great extent, and almost invariably return handsome profits.



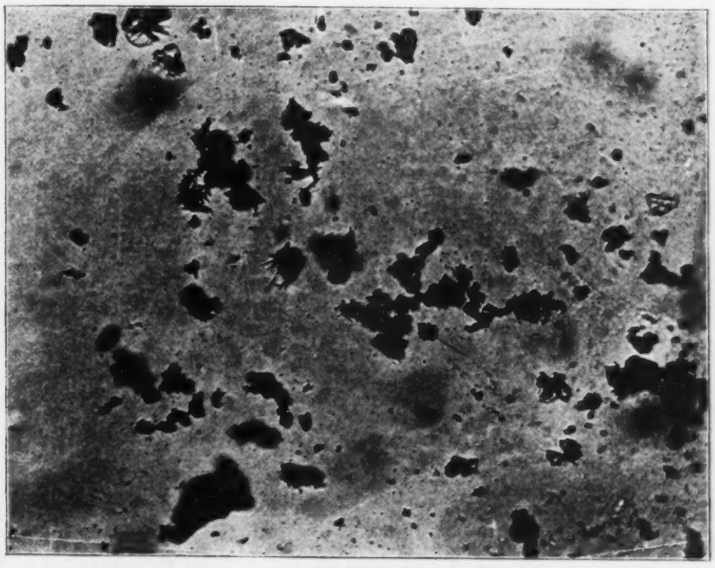
THE SPRINGFIELD STEAM ROAD ROLLER. THE O. S. KELLY CO., SPRINGFIELD, O.



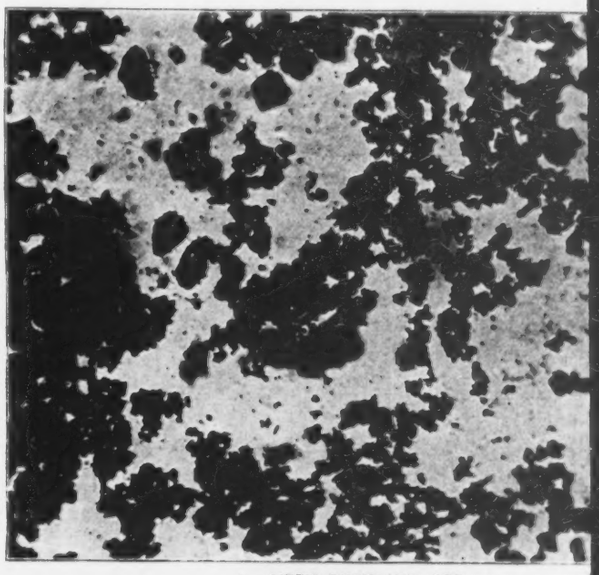
1. BUCKEYE (DRY.)



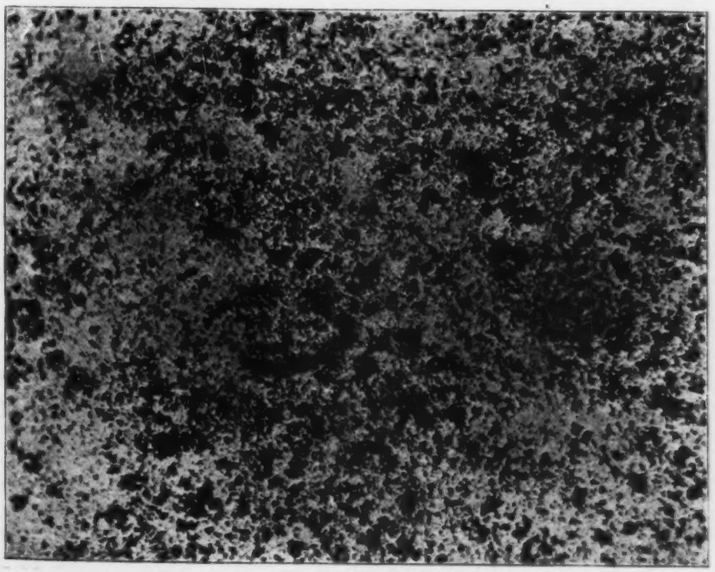
2. GIBB'S PORTLAND (DRY.)



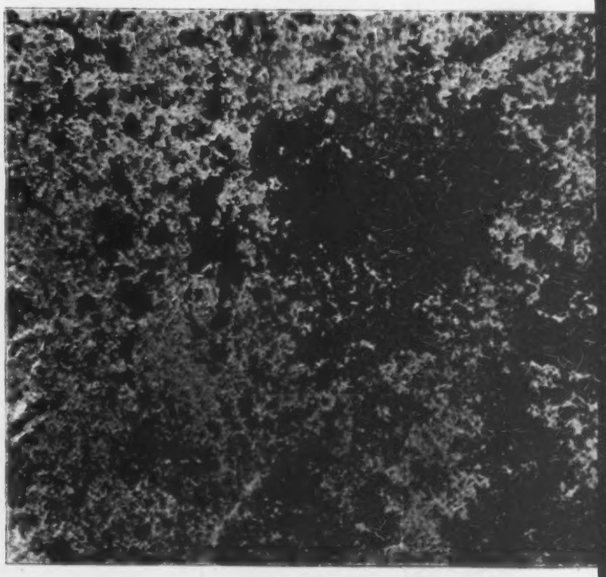
8. BUCKEYE (SET.)



9. GIBB'S PORTLAND (SET)

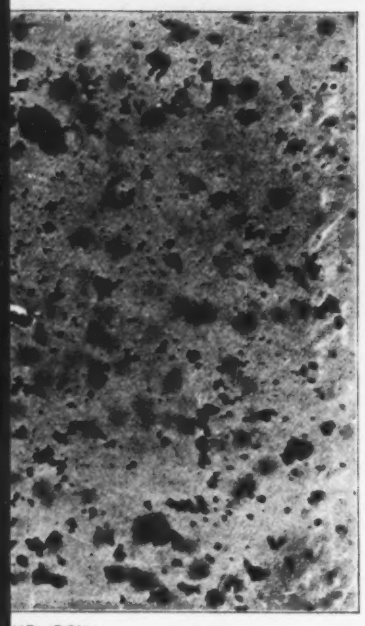


5. UTICA BLACK BALL (DRY.)

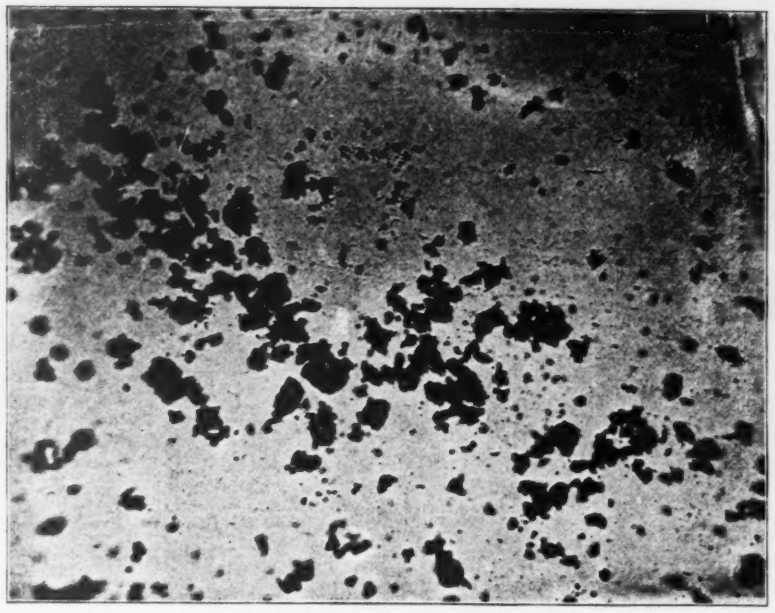


12. UTICA BLACK BALL (SET.)

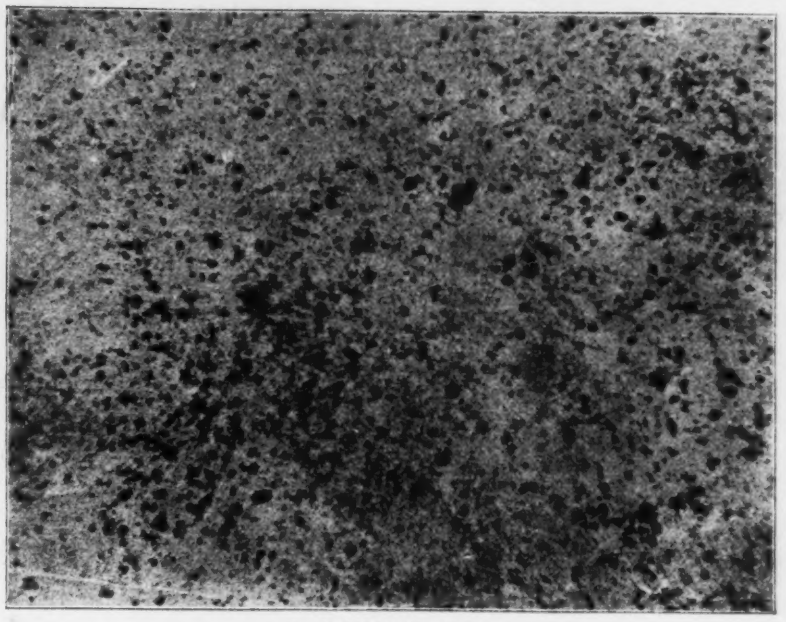
MICROSCOPIC TESTS OF CEMENT.



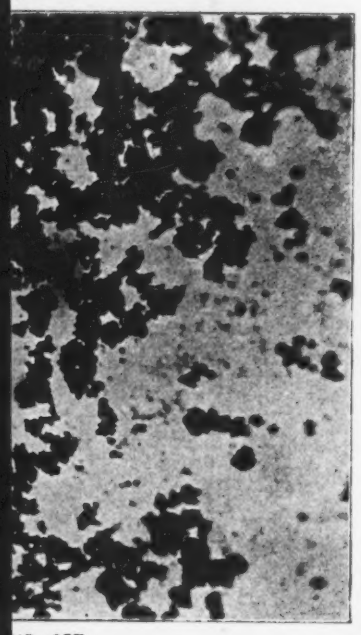
ND (DRY.)



3. SOUTH BEND (DRY.)



7. MILWAUKEE (DRY.)



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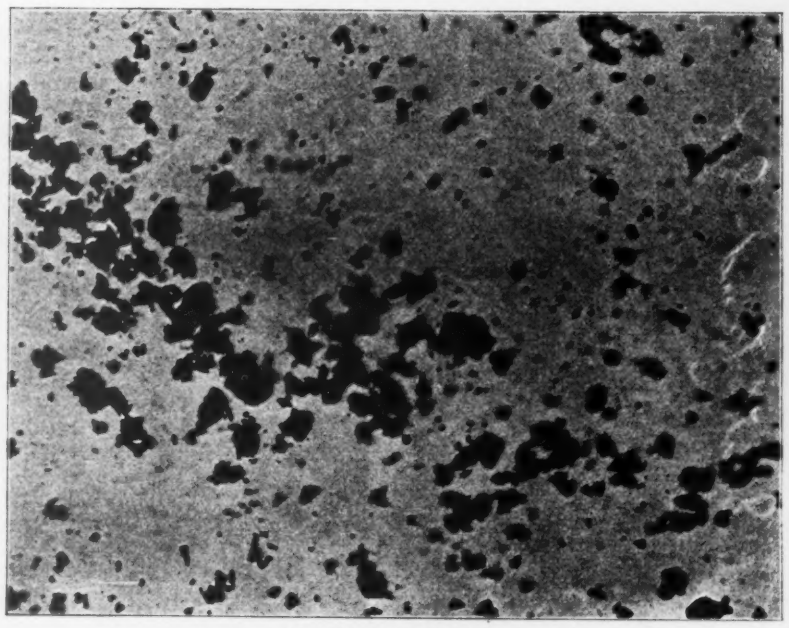
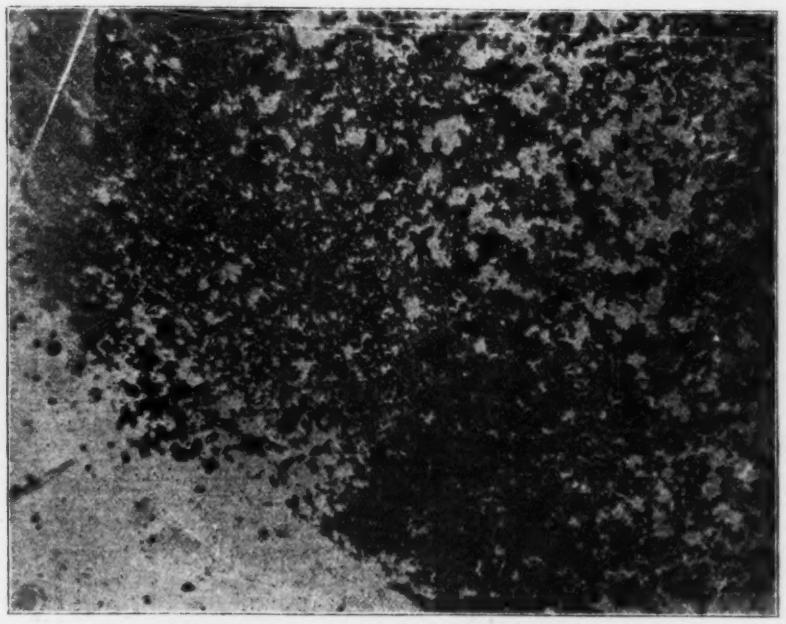
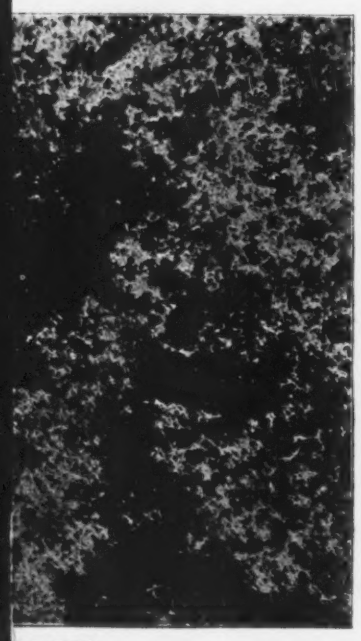


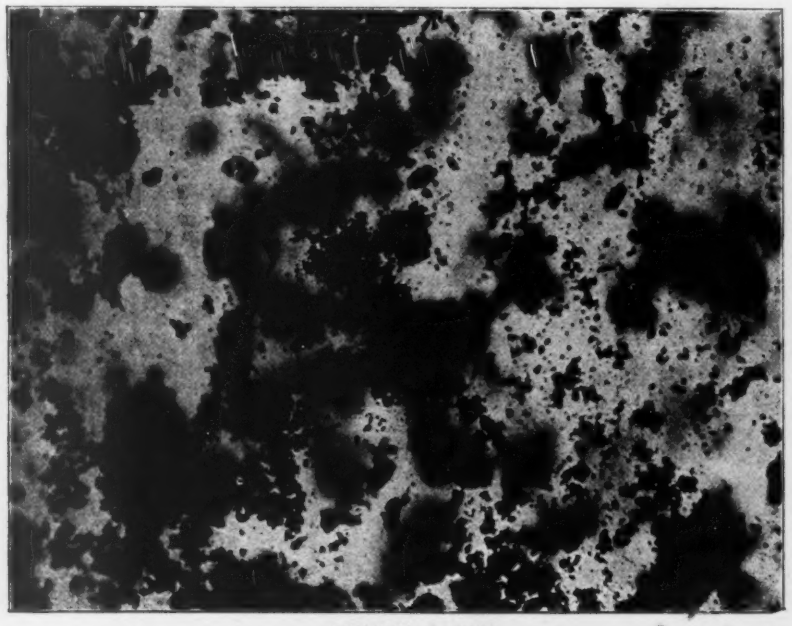
10. SOUTH BEND (SET.)



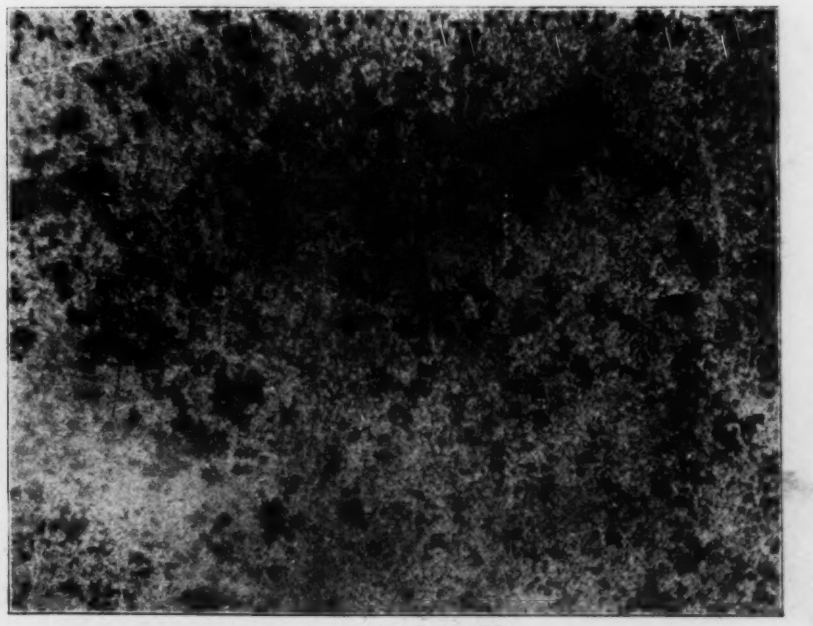
14. MILWAUKEE (SET.)



ALL (SET.)



4. ROSENDALE (DRY.)



13. J. CLARK, UTICA (SET.)

OF CEMENT. MADE BY MR. ALDEN H. BROWN, UNIVERSITY OF IOWA.

Labor Cost of Iron Output at Home and Abroad.

Part 2 of the report of Commissioner of Labor CARROLL D. WRIGHT contains some exceedingly interesting and valuable records, more fully described in another column, showing for every class of labor separately, and for the average or total of all labor, the earnings per hour of all the workmen on the payroll of the several establishments and the output in tons per hour. These statistics are made up from actual copies of a year's payrolls of 99 different establishments, which in respect to trade and location were divided as follows:

	Pig iron furnaces.	Iron ore.	Muck bar mills.	Steel ingot mills.	Steel rail mills.	Total.
Northern district U. S.	55	11	18	7	2	114
Southern " "	21					
Continent of Europe	5	..	1	3	5	14
Great Britain	3	..	3	2	1	9
Total	84	11	22	12	8	137

The 99 establishments whose payrolls were copied represent 137 different establishments in the above list, some 39 of them (one of which we omit as recently established) appearing twice in the list.

For some reason which we do not clearly understand, perhaps the fact that in a very large percentage of the establishments there were certain small amounts of labor on piece work and the like which had to be estimated in hours before the average wages and average output per hour could be determined, the commissioner neglects to make a general tabulation, such as we give below, showing the averages for each country in each of the five different departments of the iron industry examined. We have made the necessary computations to give these averages, however, and they are shown in the foregoing table.

In this table we give in separate lines the average for the works which could be computed exactly, and the average for those for which the time for certain classes of piecework, etc., had to be estimated. It will be seen that in the main they correspond fairly well, and we see no reason to question that the table as a whole may be accepted as accurate, and certainly as far more accurate than any similar table of equally wide range heretofore compiled. As we have said, the details down to the last degree of minuteness desired are to be found in the report itself. We pass these by and merely give the averages and general result.

In regard to wages, the average earnings per hour of every person borne on the payroll, deduced by dividing the total number of hours worked by the total amount of the payroll, may be tabulated as follows:

Average earnings in cents per hour in	Pig iron furnaces. No.	Pig iron furnaces. So.	Pig iron ore mines.	Muck bar iron.	Steel ingots.	Steel rails.
United States	13.57	11.03	13.30	22.03	16.99	17.90
	14.20	11.92		23.12		
Continent	5.14		.....	6.80	5.83	7.00
Great Britain	8.27		.....	11.93	15.55	12.10
RATIO (Continental = 1.00):						
United States	2.75	2.30	.....	3.37	2.92	2.56
Continent	1.00		.....	1.00	1.00	1.00
Great Britain	1 61		.....	1.75	2.65	1.73
Ratio U. S. to British	1.82	1.52	.....	1.92	1.10	1.48

It will be seen that the wages here range from 2½ to 3 times those of the continent, while British wages range a little less than 1½ times. The ratio of American to British wages is about as 1½ to 1. As the proportion of skilled to unskilled labor is likely to be about the same in home and foreign works of a similar class, these ratios ought to give a very fair idea of the real difference in average wages, a better one, perhaps, than if it were attempted to compare the several classes of labor together independently. The difference is very considerable, but the following similar table will show that the difference in output is also very considerable:

Average output in tons per hour in	Pig iron furnaces. No.	Pig iron furnaces. So.	Iron ore mines.	Muck bar iron.	Steel ingots.	Steel rails.
United States	.0778	.0800	.1509	.0307	.1021	.1225
	.1004	.0805		.0328		
Continent	.0804		.....	.0390	.0817	.0368
Great Britain	.1120		.....	.0853	.0637	.0820
RATIO (Continent = 1.00):						
United States	1.25—1.00		.....	0.82	1.25	3.42
Continent	1.00		.....	1.00	1.00	1.00
Great Britain	1.39		.....	0.91	0.78	2.29

The most salient feature of this table is the enormously greater effectiveness of American labor in the steel industry, and especially in making steel rails. This superiority is not maintained in the pig iron industry, in part for obvious reasons. We average but little better than the Continent and not quite so well as Great Britain.

The total labor cost per ton in money and in hours of time can be studied sufficiently well in the last two columns of the main table above without making any retabulation. The total *direct* labor cost of a ton of finished product may be easily deduced from the main table by mere addition, but such addition will omit the cost of coal and of labor for getting it, of transportation of both coal and ore, of management, of capital invested and profit, of material and labor for repairs to buildings and plant (except as represented in the totals of the regular pay rolls), and of a number of other items, besides the considerable one of wastage. A ton of pig iron, of course, will not make a ton of rails, and still less a ton of ore a ton of pig. But after all allowances for these important facts are made, the aggregate cost of the labor which goes to make a ton of steel rails appears to be surprisingly little, and less than most statements of the kind have heretofore shown it to be. We refrain from attempting any precise summary, as the necessary data are not before us, but the figures given are worth some study.

TABLE SHOWING THE COMPARATIVE EFFICIENCY OF LABOR IN THE LEADING IRON TRADES, IN THE NORTHERN U. S., SOUTHERN U. S., GREAT BRITAIN AND THE CONTINENT:

[Deduced from the information given as to separate works in Table XVIII of Report of CARROLL D. WRIGHT, Commissioner of Labor, Part 2.]

NOTE.—The first two columns (earnings per hour and product per hour) are deduced by the mere addition and averaging of similar figures for the separate works as given in the report. The last column (labor cost per ton) is deduced directly from the first two columns by simple division. It gives the *total cost* per ton for all labor on the payroll, including foremen and time-keepers, but not including book-keepers, office staff and managers.

PIG IRON.

	No. of works av'g'd.	Average earnings, cts. per hour.	Average product, tons per hr.	Consequent labor cost per ton in— Money.	Hours time.
Northern U. S.	4*	13 57*	.0778*	$1.83*	12.85*
	5	14.20	.1004	1.41	9.96
Southern U. S.	3	11.04	.0800	1 38	12.50
	18	11.92	.0805	1.48	12.42
Continent	5	5.14	.0804	0.64	12.44
Great Britain	3	8.27	.1120	0.74	8.93

IRON ORE.

United States	11*	13.30*	.1509*	$0.92	7.35

MUCK BAR IRON.

United States	3*	22.03*	.0307*	$7.21*	29 93*
	15	23 12	.0328	7.05	30.99
Continent	1	6.80	.0390	1.74	25.64
Great Britain	3	11.93	.0353	3.37	28.33

STEEL INGOTS.

United States	7	16.99	.1021	$1.66	9.79
Continent	3	5 83	.0817	0.71	12.24
Great Britain	2	15.55	.0637	2.44	15.70

STEEL RAILS.

United States	2	17.90	.1225	$0.68	8.16
Continent	5	7.00	.0368	0.53	27.17
Great Britain	1*	12.10*	.0820*	1.48*	12.20*

* The numbers starred are precise; the computation of the others required more or less allowances for time on piece work so that they may vary slightly from precision, but probably in no case to any important extent.

The Mechanical Engineers' Meeting.

However much one may be disposed to regret it, it is becoming increasingly clear that there are to be four co-equal and co-ordinate engineering societies in this country, occupying each a quarter more or less of the entire field, rather than one single great society to which all others are appendages, as in England. At least, unless there is some marked change in present tendencies this is sure to be the case, for we may be said to have already three national societies of substantially equal membership and weight, the Civil, Mechanical and Mining societies, while the Electrical, though a younger and as yet much smaller society, occupies such a rapidly enlarging field that it may yet become the largest and most important of them all.

On the other hand, in England the Institution of Civil Engineers has such a lead over all others that it seems likely ever to remain *the* society of all others to which engineers practicing in every department of "civil" as distinguished from military engineering will wish to belong. Circumstances have somewhat favored the Institution in firmly establishing this broad interpretation of the word "civil" in the minds of its members. In America, it is all but universally given the narrower signification which we need not define, and which makes it rather the antithesis of "mechanical," "mining" or "electrical" engineering, than a broad, inclusive term which covers them all, as opposed to military engineering.

Certainly the last meeting of the Mechanical Engineers has done much to bring that society abreast with its two leading rivals, both of which have heretofore largely exceeded it in numbers, and one of them in dues also. Dues are a crude test by which to judge the timber of which a society is composed, but after all it is a natural and not inaccurate one. The society which courts members by charging low dues may be a useful educational institution, but its prestige will suffer. Membership in it will not be regarded as in any sense an indication of professional standing, and thus in the end the society may be weakened. The Civil Engineers' Society has heretofore charged the highest dues, and has undoubtedly gained a certain prestige therefrom as the leading society. This it can enjoy no longer. The Mechanicals' yearly dues are now equally high ($15 for full members), while the entrance fee, though not yet quite so high as the Civils' ($30), has been advanced from $15 to $25, or to substantial equality, and it is significant that this was done by a practically unanimous vote of the membership. The Mining Engineers, who have always frowned upon any policy of exclusiveness, charge only $10 for both entrance and annual fees. Naturally, their growth and numbers are very great.

Nevertheless, the American Society of Mechanical Engineers is shown by the late reports to be forging ahead rapidly in numbers also. The Mining society had by its last list of members (May, 1891) 2,134 members of all grades, against 1,974 the year before, an increase of 160. The Civil Engineers enumerate in their last list (Aug. 31, 1891) 1,436 members of all grades (1,138 being voting members) against 1,334 (1,068 voting members) the year before, an increase of 102. The Mechanical Engineers, by the report abstracted in another column, show a membership of 1,443, or practically the same as the Civil Engineers, and their increase has been much more rapid, as the following figures of their membership on Jan. 11 of successive years will show, when contrasted with corresponding figures for the Civil Engineers:

1880.	1881.	1882.	1883.	1884.	1885.
189	219	294	364	440	558
1886.	1887.	1888.	1889.	1890.	1891.
605	714	801	875	1,049	1,2 2
Nov. 19, 1891, as above					1,443

Whether the increase in dues just consummated will check this growth remains to be seen, but in

view of the unanimity shown in adopting that increase it is hardly likely that it will.

Another circumstance, not yet generally known, points to this conclusion. So far as the relative number of college graduates can indicate it, mechanical engineering as a profession is rapidly forging ahead of "civil" engineering (using that term in the accepted narrow sense) in numbers and importance. A few years ago the great majority of graduates from our technical schools graduated into civil engineering and the number of mechanical graduates was small. At the present time the two stand nearly neck and neck (the "mining" graduates being nowhere) but the mechanicals have been increasing in number so much more rapidly as to make it clear that their number will soon be far greater than the civils. These facts are shown in some elaborate statistics of our technical schools which we have lately collected and shall soon publish, and it is a fair inference that the field for mechanical engineers, like the number of graduates, is becoming larger than for "civils." It has been so in England. It is natural that it should be so here. There is a limit to the field for engineers in the construction of public works. There must come a time (which has already come in England) when the demand for new works of that kind has been pretty well filled. There is absolutely no limit (at least none yet in sight) to the demand for improved machinery and mechanical appliances.

Fortunately for the Institution of Civil Engineers, the rapid advance to prominence of mechanical engineering, and relative decadence of purely "civil" engineering, occurred while it was yet the only engineering society of any importance in England. It therefore gained decided and decisive "all-round" strength in all departments of engineering before any rival society had come into existence. Nor is it to be denied that its policy has been steadily and intelligently directed to this end from the first. Fortunately for the American Society of Mechanical Engineers, and unfortunately for the American Society of Civil Engineers, the latter society did not attempt to make this broad inclusive membership a feature of its policy; on the contrary, the Am. Soc. M. E. society was formed chiefly by malcontents within the Am. Soc. C. E., who found the latter inadequate for their needs, and who formed their own more specialized society while mechanical engineering as a scientific profession was yet young in this country, and while the older "civil" society was not yet great enough to have an irresistible attraction of gravitation.

Perhaps it is better that it should be so. This is a larger country than England, and has even now many more practicing engineers. Each of our four leading societies will soon have 3,000 or more members, and that is as many perhaps as it is well to have in any one society. That the American Society of Mechanical Engineers is even now playing no minor part, but rather a leading part among the societies is becoming evident by many little signs. For example, their New York meeting this week was much more largely attended than any meeting of the Civil Engineers has ever been. We should say there were nearly twice as many members in attendance as have ever attended any of the "civil" meetings. Their new society house, though the most commodious in the city, was far too small for the meeting, and a large assembly hall was rented for one evening, and the Lenox Lyceum for another. The society house also serves as a local headquarters for many of the out-of-town members, to the great advantage of the society's revenue, as well as convenience of the membership, there being two floors of lodgings which are let to them.

Another little device tending to make the meetings useful and popular was first used at this meeting, we believe. The visits to various engineering works are always a hard matter to arrange so that members shall derive any profit from it. If they go in a body they stand in each other's way; if they try to go separately they do not know their way about, and have only the standing of individual visitors. To obviate these difficulties, two separate afternoons at the late meeting were devoted to individual excursions. Sixteen different numbered cards like the subjoined sample, which sufficiently explains itself, were placed in as many different boxes along the mantle-piece, and members were left to look them over and make their own selection.

> **1** MORGAN AND QUINTARD IRON WORKS.
> AVENUE D AND EAST 9TH AND 11TH STS.
>
> Cross-town cars to Eighth Street to Avenue D, within a block of each. Take any up and down-town line of cars except the green line on Broadway, down to Eighth Street.
>
> At Morgan Iron Works ask for JOHN C. KAFER.
>
> At Quintard Iron Works ask for Mr. PALMER or Mr. WILSON.
>
> HAVE YOUR BADGE OR BUTTON WITH YOU.

This is plainly a good idea, and worthy of more general adoption.

THE CELLULOSE COMPANY, of Philadelphia, Mr. A. G. OSTHEIMER, President, is building works on the Schuylkill in that city for the manufacture of water-tight lining for war-ships. This material, made of cocoanut husk fibre, is to be used on the cruiser *Detroit*, recently launched, and probably on all other war vessels built by the government. The *Detroit* will require about 500 cu. ft. of the cellulose, says an exchange.

STREET CAR HEATING BY ELECTRICITY is to be tried in Milwaukee, and a car is now being built for this purpose by the Milwaukee Street R. R. Co. According to the crude description given in the local press, electricity is to be used to heat a metallic plate running under the seats, protected by iron network. A Mr. CARPENTER, of St. Paul, is said to be the inventor of the system, but it is figured that the apparatus will cost $40 per car and use 2 E. HP. per trip in heating.

THE ENGINEERING DEPARTMENT OF THE UNIVERSITY OF PENNSYLVANIA is being increased by the erection of several new buildings. Engineering Hall is to contain one Porter-Allen and one Straight-line engine of 50 HP. each and two compound Westinghouse engines of 100 HP. There will also be four direct current dynamos with a capacity of 2,000 lights, for the lighting of the near buildings and two alternating machines for buildings at a greater distance. The hall will contain class rooms, large mechanical and electrical laboratories, and drawing, blue-print and model rooms. There is to be a boiler house with 1,170 HP., distributed in Galloway, water tube, tubular and Harrison boilers. The engineering department will, with these additions, accommodate 120 students. There are now 67 students.

RAIN-MAKING EXPERIMENTS have been tried near Madras, India, says a London news item of Nov. 15. Dynamite was exploded on near hills at an altitude of 500 ft., and these are said to have produced "smart showers over an area of four or five miles square." It is also stated that the government will probably cause systematic tests to be made in the arrest of moisture-bearing clouds passing over to the sea.

RAIN MAKING in Texas was a failure, we are at last officially informed by Mr. GEORGE EDWARD CURTIS, of the Smithsonian Institution, who was sent to Texas by Mr. B. E. FERNOW, Chief of the Forestry Division of the Department of Agriculture. He was with Gen. DYRENFERTH'S party for three weeks and says that during that time $\frac{7}{100}$ in. of rain fell, notwithstanding the extraordinary reports sent out to the press. Mr. CURTIS was the meteorologist of the party, and further says that in all the Texas experiments fewer balloons were exploded than in one afternoon in the preliminary tests near Washington. This was due to the failure of the furnace for generating gas. The sticks of the kites were too weak to stand the Texas winds, and they did not have men enough to handle them. The rackarock was all right, and one day when the clouds were near the earth the explosion of a few charges brought down a few drops of rain. A slight shower followed, 16 hours after the explosion of a preliminary and experimental charge of rackarock, and this shower was telegraphed over the country as a howling success. Dr. CURTIS says the explosion had "absolutely nothing to do with the rain," and Gen. DYRENFERTH so acknowledged it. There were slight showers all over Texas that afternoon, hundreds of miles from the point of experiment. He says the whole thing is "devoid of practical or commercial value."

THE NEW FAST TRAIN to Buffalo is already running overcrowded, it having been necessary this week to turn away several passengers because every seat was occupied. It is therefore under contemplation to build some new and longer cars for this service, it being deemed inexpedient to attempt to add a fifth car to the regular train. This result well illustrates the tendency of improvements in service to increase traffic, for the previously existing part of the traffic which now fills a four-car train was heretofore only that which was carried in the spare seats of the New York-Chicago limited. A brief computation will show that a train which has every seat in even three cars filled is earning a great deal of money.

THE QUESTION OF SEWAGE DISPOSAL is being considered by several cities in England, and among the latest is Guildford, which proposes to borrow $175,000 for purposes of sewerage and sewage disposal works. The matter has been carefully considered by the Town Council for several years, and in 1888 they appointed a committee which visited many places where sewage works were in operation, and reported that the sewage should be dealt with by the system of the International Water & Sewage Purification Co., which they saw in successful operation at Acton. Under that system the sewage is first treated in precipitation tanks with ferozone to remove the solids, and is then passed through polarite beds, such as were in successful use at Acton, Hendon and other places. These polarite beds had a remarkable effect in rapidly oxidizing the organic matter in solution, and analysis showed that this process produced a very pure effluent. Mr. C. N. LAILEY and other engineers, several of whom recommended the International process, prepared plans for the scheme, and Mr. LAILEY'S plans were finally selected and accordingly adopted by the Sanitary Authority. A large landowner having a residence near the proposed outfall works engaged Mr. BALDWIN LATHAM to consider whether the purification works as recommended were likely to cause a nuisance, and it was reported that he had no hesitation in saying that works of this character, if properly designed and carried out and attended to, could be made satisfactorily to deal with the sewage without the slightest nuisance arising even on the land itself. The late Sir JOSEPH BAZALGETTE also reported in favor of the scheme. It is necessary to have the best system, because the effluent will discharge into the River Wey and ultimately reach the Thames above the London water companies' intake.

BREADSTUFF EXPORTS show the following remarkable rate of increase over last year, and the shipments to supply the European deficiency have but fairly begun:

	1890.	1891.
Month of October	$8,343,246	$21,463,334
4 mos. ending with October	36,997,473	101,158,156
10 mos. " " "	119,037,156	169,488,463

LEAD POISONING, from the use of lead pipe in water supply, says the London *Lancet*, is one of the most important problems submitted to modern investigators, and a sub-committee of the Sheffield Water Corporation is preparing a report upon this subject. Since March, 1890, the water supply of that city has been continuously treated with chalk for the purpose of preventing lead poisoning. They report that this treatment has removed the cause of complaint, and recommend its continuance. They are now studying the best apparatus or process for automatically adding the proper proportion of carbonate of lime, in the form of chalk, to the water furnished for consumption.

CORRESPONDENCE.

The Largest Dry Dock on the Lakes.

PORT HURON, Mich., Nov. 10, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In the ENGINEERING NEWS of Oct. 31 I see the description of Detroit's new dry dock, and as it is called the largest on the lakes I would like to call attention to the dimensions of Dunford & Alverson's new dry dock at Port Huron. The dock is now completed and has been in successful operation over a month. Length, 412 ft.; width at top, 95 ft.; width at floor, 55 ft.; depth of water on floor, 20 ft.; on keel blocks 16 ft.; width of gate, 64 ft. The pumps have capacity to empty the dock in 90 min.

F. F. ROGERS,
City Engineer.

The Fastest Train in the World.

Johns Hopkins University.
BALTIMORE, Md., Nov. 10, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I see in your issue of Oct. 31 the statement that the fastest regular train in the world is the New York Central express from New York to Buffalo, which has an average speed, including stops, of 50.72 miles. [Excluding stops, 52.12 miles.—ED.] I think this is a mistake, for there is an express in Germany, from Berlin to Hamburg, which makes the entire distance of 177.77 miles in three (3) hours, twenty-four (24) minutes. This is an average rate of speed, including stops, of 52.28 miles. L.

[According to the only copy of the Continental Bradshaw we have at hand, which is for just a year ago, the fastest train between Bremen and Berlin made the run in 4 h. 10 m., the others taking 5:29; 7:11; 7:18; 6:38 and 6:45 respectively, and the distance (which is usually given to ¼ mile) is given as 177 miles only. This fractional difference of distance alone reduces the speed to 52.05 miles per hour. We presume our correspondent has grounds for his statement as to the present schedule, however, and if so, this train would appear to be the fastest in the world.—ED. ENG. NEWS.]

Iron Range & Huron Bay Railroad Co.—Correction.

DETROIT, Mich., Nov. 10, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I would like very much to know who furnished you the information relative to my alleged resignation as Chief Engineer of the Iron Range & Huron Bay R. R. Whoever furnished it manufactured the report out of the whole cloth, as I have neither resigned nor been discharged. My relations with the company are perfectly satisfactory, and I have no intention of resigning whatever. The work on the road is in such a shape at present as not to require the presence of any of my corps, except Mr. MILLER, one of my assistants, who will remain north until spring. Owing to the closeness of money matters our company will not be able to lay any steel before next spring. As a subscriber for your paper, I hope you will at once correct the statement made in your last issue. Yours truly, MILO DAVIS,
Chief Engineer I. R. & H. B. R. R. Co.

[The statement has appeared in a large number of Michigan papers, from which it was clipped for our news columns.—ED. ENG. NEWS.]

Sharp Curves in Yards.

ST. LOUIS, Mo., Nov. 14, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to the inquiry of "Engineer" as to practicability of curves of 100 ft. radius in yard work, there is no difficulty in operating such curves with ordinary yard engines. In rear of the roundhouse at Third and Wood Sts., Cincinnati, the C., C., C. & St. L. (Big Four) Ry. has two curves of 70 ft. radius, around which cars pass without difficulty, and which is readily traversed by a "pony" engine of 7 ft. 6 ins. wheel base. The water hose connections between engine and tender were placed under center, and the shackle bar was slightly lengthened to prevent corner of engine cab and tender from jamming. The links between cars are replaced by bars with pin holes about 12 ins. apart to prevent corners of car striking. With these slight changes there is no difficulty in running cars and engine around these curves. The gage is 4 ft. 8½ ins. and is spread 1½ ins. on these curves.

I understand the "Pan Handle" has several curves of 90 ft. radius in their Smith St. yards, Cincinnati, which are readily traversed by switching engines with 6 drivers.

SHARP CURVES

Progress in the Tin Plate Industry.

CINCINNATI, O., Nov. 9, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: We beg to trespass on your patience with the inclosed slip. You will understand that this is a *business* and not a *political* matter with the sheet iron industries of this country. If by 1893 we do not produce one-third the amount of tin plate that is imported, the duty goes off this article, and neither our manufacturers, workmen nor the government itself will get the benefit of the business.

In requesting you to publish at least an extract from this article, we assure you that our efforts are in the direction of helping to encourage and stimulate this industry by example and precept, and not merely for advertising purposes. We expect to be one of the concerns which will in the aggregate make by 1892 two-thirds as much tin plate as is imported.

THE CINCINNATI CORRUGATING CO.

[The inclosed slip contains details of a considerable addition to the plant of the company and of the erection of a new building (size not stated) to contain the same.—ED. ENG. NEWS.]

Cost of Masonry—A Creditable Record.

TUSKALOOSA, Ala., Nov. 10, 1891.

TO THE EDITOR OF ENGINEERING NEWS.

SIR: During the month of October, 1891, two gangs of masons, using two derricks, laid, on the north wall of Lock 2, Black Warrior River Improvement, Tuskaloosa, Ala., 1,563 cu. yds. of first class mansonry at a total cost for labor and fuel of $1,445.79, or 92½ c. per cu. yd. This included the cost of all labor used in screening sand and gravel, mixing mortar and concrete, operating steam hoists, unloading materials at the wall and converting them into masonry; also fuel for steam hoists. The cost may be itemized as follows:

Foreman	1 mo.				$90.00
Masons	262 days of 8 hrs. at			$2.80	565.60
Laborers	35½	"	"	1.20	42.15
"	270½	"	"	1.00	270.50
"	369⅜	"	"	.80	295.70
"	146¾	"	"	.60	88.05
Boys	83¼	"	"	.40	33.30
Wages paid in board					42.00
Fuel					18 49
					$1,445.79

Laborers were rated according to their capacity.

The wall is 390½ ft. long, 8 to 14 ft. wide, 31 to 36 ft. high, and built in courses of ashlar 18 to 24 ins. thick. The front is pointed; the back is rock face, and the interior is rubble laid in gravel concrete; about 50 per cent of the wall being cut stone, and the balance filling. The mansonry is first class in every respect. The stone used is a fine quality of light blue sandstone quarried from falls in the bed of the river ¾ mile above the lock, the water being turned from the quarry by a dam.

During the same month of October 200 cu. yds. of backing, and 600 cu. yds. of dimension stone were quarried by the "Knox system" of blasting, at a total cost of $1,597.73. Allowing $1.00 per cu. yd. for the cost of backing, the dimension stone cost $2.33 per cu. yd.; 434 cu. yds. of stone, including 20 cu. yds. of coping, were cut during the month at a total cost of $2,965, or $6.83 per cu. yd.

I consider the cost of laying the masonry as given above (92½ cts. per cu. yd.) quite cheap, and think the amount of work done is larger than usual for the force employed.

Can you or some of your correspondents tell me whether this would be considered cheap and rapid building in the Northern or Eastern States?

R. C. MCCALLA, JR.

[It would appear from the above record that the total cost per cubic yard of this wall, with about half of it "cut stone" (which term cannot be used in the ordinary sense, since the wall was 8 to 14 ft. thick), was about $6.00 per yard, excluding only cost of cement. This is certainly very low for really first class work, as we understand this to have been. Whether it can be paralleled in the North and East we leave for our readers to say.—ED. ENG. NEWS.]

The Indianapolis Cattle Guard Tests.

KALAMAZOO, Mich., Nov. 4, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of Oct. 24, you give an account of a test of cattle guards at Indianapolis on Oct. 13. The writer is correct in his account of the test, but I think his article leaves a wrong impression on the mind of the reader. The test simply demonstrated that cattle will (under certain conditions) cross any guard that has been made. That fact is well known to all track men that have had charge of maintenance of way for any length of time, but in case of a pit guard the animal is liable to become fastened in the guard and cause a wreck, whereas if it had been a surface guard the animal would have crossed the guard and could have been turned from the right of way by the track men, saving the animal itself and the wreck also.

Futhermore, in the construction of a railway the engineer will study and work to save small openings in the roadbed; he will build expensive arch culverts; use large iron pipe or dig a long ditch in order to avoid an open bridge; but the moment the track comes and the fences are built, two large holes are dug at every highway crossing for pit cattle guards, and in a settled country this happens at least once in every mile, thus making a trap for cattle and an element of danger for the train in every mile of road.

We do not claim that surface cattle guards are a "sure cure" for all kinds of animals, but we do claim that they are as sure as the old pit, with no element of danger to the cattle or train. I cannot express my self better than to quote from a private letter written by a gentleman now in charge of over 2,000 miles of road. He says:

I consider that the service cattle guard is one of the greatest steps that have been made in railroading in the last few years. Half the openings on our line are at present pit cattle guards, and in case of a derailed truck or wheel they are as liable to cause a serious accident as a much larger or deeper opening. Further, I consider that they are a dangerous appliance for keeping stock off the right of way as the stock is liable to be thrown into the pit and derail the train. We had a case of this kind only two or three months since which cost the company about $4,000 and the lives of two of its employees. Another company near here had a case only a few weeks ago that must have cost as much and the life of one of its employees. The stock frequently falls into the pit when trying to pass from the highway to the railroad right of way, and in event of being struck by the train an accident is sure to follow. Our experience is that the pilots of the engine will throw stock off the track, but when stock is struck in the pit derailment is almost certain.

In regard to the expense of the guard, the steel guard is the cheapest in first cost and also in the expense of maintenance. Therefore the deduction is that all roads will in a few years adopt some style of surface cattle guard.

FRANK C. BALCH, *Secy.* Bush Cattle Guard Co.

[We fully agree with our correspondent's position that a pit opening in the track is a great evil, an unceasing source of danger (and as a rule of rough riding as well) which should be avoided even at some sacrifice of efficiency in turning stock; nor does it appear to us that the tests indicated any decided and material difference between the pit and surface guards in ability to turn stock under ordinary conditions. Piling heaps of succulent corn stalks just beyond a cattle guard is a pretty severe test. Except for its tediousness the truer test would be to pen the cattle in not too small a pen, supply them sparingly with food and water, and then see how long it would be before mere restlessness and passable grazing would tempt them to try to pass the guards.—ED. ENG. NEWS.]

Notes and Queries.

B. H. L. asks whether side-wheel steamboats can be fitted with "feathering paddles," and, if so, how are they arranged? They are not used very extensively in this country, but are almost universal abroad, where the paddle wheels are apt to be much smaller than here. Drawings of the various devices can be found in almost any marine engineering treatise.

D. B. O., of Tacoma, Wash., asks for data relating to the effect upon brickwork of immersion in sea-water for, say, 24 hours. As to the effect of sea-water used in making cement mortar, a paper by Mr. M. I. POWERS, of the University of Iowa, is given in this issue, detailing the results of his experiments. Other valuable experiments will be found set forth in the reports of the Chief of Engineers, U. S. Army, of various dates, which can be readily secured.

Influence of the Steam Jackets of the Pawtucket Pumping Engine.

Both the steam jacket and the Pawtucket pumping engine have been pretty thoroughly discussed before the American Society of Mechanical Engineers; and all its members probably know now that the Pawtucket engine is one of the most efficient steam pumps in the world. As for the jacket, the Pawtucket experiments seem to show that it uses about as much steam as it saves. Prof. DENTON, from his tests, reported at length in our issues of Dec. 28, 1889, *et seq.*, concluded that the jacket "probably caused no loss, and may possibly have caused a saving not exceeding 3% of the total consumption." Prof. JACOBUS, after tests reported at the Cincinnati meeting of the Society in May, 1890, concluded that the economy of the plant "is about 1.7% in favor of using the flue reheater, and 2.5% in favor of using both jackets and flue reheater over that obtained when neither flue reheater nor jackets are used."

At Prof. DENTON'S request, Mr. WM. KENT made a careful test of the engine last May, the result of which proves the practical correctness of the two former series of tests and the conclusions deduced from them. We quote the following from Mr. KENT'S paper read before the American Society of Mechanical Engineers at this week's meeting summarizing his conclusions:

Prof. DENTON in his paper lays great stress on the errors of indicator diagrams and their measurement, so that he says the apparent saving of from 0.13 to 0.35 lbs. of steam per HP. per hour is within the limit of error to

which the determination of indicated HP. and cut-offs is subjected, so that he will not admit more than that the jackets only *possibly* caused a saving. It seems to the writer, however, that the variable errors in diagrams taken by several different indicators, and by different observers after proper corrections for known errors of the springs, should be expected to tend to balance each other, and that although the actual error of any single diagram may be 3%, yet if a series of diagrams during a long test show an average result of from 0.13 to 0.35 lbs. saving, or from less than 1% to less than 3% in favor of the steam-jackets, that result, small as it is, should be accepted as highly probable rather than merely possible, until other results overthrow it. Prof. JACOBUS' tests, reported in his paper, also have the same tendency to show uniformly a very slight saving by the use of the jackets, and the tests now reported confirm the results both of Prof. JACOBUS and Prof. DENTON in showing that the jackets do give a saving, but that the saving is very slight, ranging from about 1 to less than 4%. . . .

The tests above reported, however, do not lead to any more general conclusion than that jackets may be expected to give this saving in a cross-compound Corliss engine of 140 HP., running at about 50 revolutions per minute, supplied with dry steam of 125 lbs. gage pressure, and cutting off at about one-quarter stroke in the high and one-third stroke in the low pressure cylinder. Before this conclusion can be expanded to apply to other engines, there should be tests made with equal precautions and refinements to those made with the Pawtucket engine, on such other engines, with different dimensions and different conditions, such as pressure of steam, moisture or superheat in the steam, speed of revolution, number of expansions in the two cylinders, &c.

It is gratifying to be able to confirm the general results as to the economy of the Pawtucket engine which have been found by Profs. DENTON and JACOBUS, as well as those that have been made by Mr. WALKER, the Engineer of the water-works. It is worthy of notice, also, that this engine, built nearly 15 years ago, has not yet been surpassed in economy by any two cylinder compound engine, nor as a pumping engine has it yet been surpassed by any type of engine whatever.

The Richmond & Danville Bridge Disaster.

The accompanying engraving, prepared from a photograph, shows the condition of the wrecked bridge across the Dan River, on the Richmond & Danville R. R., after the failure which occurred as the result of a collision on the bridge on Nov. 2. The view should have appeared in connection with the letter from Chief Engineer BOLTON, given in our last issue, together with a note from Mr. S. H. LEA transmitting the photograph, in which he gives the following revised account of the occurrence. It will be seen that there is no material conflict as to the facts, which in no way imply any weakness in the bridge.

Wreck of Bridge over Dan River, Richmond & Danville R. R.

On the north side of the river (to the left in the view, looking at the picture) there is a trestle approach about 600 ft. in length. Then comes the bridge proper, consisting of four spans, each 150 ft. long. On the south bank is a trestle approach about 75 ft. long; then a plate girder span of about 30 ft. across the tracks of the Atlantic & Danville Ry. About 700 ft. south of the bridge is the Danville passenger depot of the R & D. R. R.

The accident occurred between 5 and 6 A. M. The photograph was taken about 2 P. M. By this time the company had assembled several car loads of bridge timbers for building a temporary trestle and a force of 100 men who were clearing away the débris. The bridge is of the ordinary American type and was erected *about* 8 years ago by the Edgemoor Co. The box car next behind the engine was resting with one end on the débris and the other on the top of the pier on the right. This car was pulled away by the wrecking force a short time before the photo. was taken. Two empty coal cars went down in front of the engine.

The following account of the occurrence appeared in the local paper. The accident was doubtless caused as stated, by the coal cars being thrown off the track by the engine of the rear train. They were thrown against the cast side, as that side gave way first:

Freight train No. 46, just in from Charlotte, stood ready to pull out for Richmond. There was a shifting train in front. The vestibule train from the north was a few minutes past due and both trains pulled out in a hurry in order to cross the bridge and clear the track for the vestibule.

It was dark at the time, and when the engine of the train in the rear had passed on to the first span of the bridge it ran into a coal car which brought up the rear of the train in front, and knocked it off the track. The car broke loose from its coupling and was thrown across the track. It was then jammed against the girders of the iron superstructure, carrying the girders away and causing this entire span to collapse and fall into the river below, a distance of 25 ft. Engine 564, the box car next behind and 2 coal cars in front of it went down.

As the train in front consisted of cars that were being shifted from the Danville to the North Danville yard there was no caboose attached. The freight trains on the Richmond & Danville R. R. are equipped with air brakes, consequently they should be under the control of the engineman.

Electric Power Distribution.

At the meeting of the Iron & Steel Institute with the American Institute of Mining Engineers in New York City a year ago, Mr. H. C. SPAULDING, of Boston, presented an interesting paper on the Application of Electric Power to Mining Machinery. (See ENG. NEWS, Oct. 4, 1890.) The same gentleman read a paper at this week's meeting of the American Society of Mechanical Engineers, with the somewhat broader title of "Electric Power Distribution."

The long distance transmission of power by electricity has made greatest progress in Switzerland, where water power is abundant and coal is very expensive. There are now over 200 electric power stations in that country utilizing water-power for operating lights and motors over extended areas. The high price of coal is leading to the rapid establishment of similar plants in the Western United States; the installations at Spokane Falls and Aspen being perhaps the most widely known examples.

The author, however, confined himself in this paper chiefly to the "distribution" of electric power, and his paper described various directions in which electric power has been found advantageous.

The first noted was the displacement of shafting and belting by the use of motors driving separate machines and groups of machines. Besides the advantages in saving of power (the loss in transmission and conversion being less than the friction of shafts and belts) the reduction of fire risks by the absence of belt towers and belt holes in the floor is pointed out. It is not advisable to run any but the largest tools by separate motors; but it will usually be found advisable to group the machines in systems requiring 10 HP. or more, and so arranged that the average of power required will not vary suddenly between wide limits. Such motors may be placed on the floor, requiring no special foundation, owing to their perfect balance; or they may be connected directly to the shafting. If the latter plan be adopted, a light platform beneath the motor on which to stand while inspecting and oiling is a great convenience.

In one plant instanced by the author, more than 20 separate motors are operated at a distance of 200 to 1,400 ft. from the central engine and dynamo. One of these motors of 15 HP. operates two 36-in. planers, two 32-in. planers, six 32-in. lathes, one 42-in. lathe, one 48-in. chucking machine, four 5 ft. Prentice radial drills, and a large double grinder.

The author described what is now one of the most familiar applications of electricity, the driving of traveling cranes, and referred also to its use for passenger and freight elevators, and portable hoists for dock work, etc. The latter may be operated from lighting wires on the steamer or on shore, or from a special power circuit. Of electric elevators he said:

The earlier applications of electricity to elevator service were not specially successful, except for slow speeds, as it was not for some time considered feasible to start, stop and reverse the motor itself, thus imposing the disadvantages inherent in "open and crossed belt" machines upon all electric elevator installations.

The only practical method of using motors for high-speed passenger work was for some time, therefore, in operating the pumps of hydraulic systems; but of late the development of quick-controlling and reversing apparatus, with special types of motors, has made possible results fully equal in smoothness of operation to the best hydraulic practice, while the running expense is usually considerably less. Designs are in use for a double-drum freight or slow passenger type of machine, in which the movements of the apparatus are controlled entirely by electric means, the armature shaft of the motor being run in either direction at will, and at any desired speed.

An improved high-speed passenger machine is now in operation in a large business block in Boston, the controlling mechanism being entirely in the car and operating through flexible cables. Automatic brakes are provided which are thrown into operation by the shutting off of the current, while the usual safety devices against over-travel and breakage are present, with others of a purely electrical nature.

For operating small motors about the tracks of a mill or large manufacturing plant, electricity offers many advantages and some motors are in use heavy enough to act as a yard shifter for freight cars.

An objection sometimes offered to the adoption of electric apparatus is, that owing to the "youth of the art" the types of machines now built and on the market will in a few years be obsolete, like a coat outgrown though not outworn, so that the necessary investment is an unwise one on the part of the purchaser. This view seems to the author not fully warranted in the light of recent developments in electro-dynamics, since the efficiency of this class of machinery is now so high as to direct the ingenuity of electric engineers rather to the invention and improvement of auxiliary apparatus for controlling, measuring, and protecting the currents produced, than to the invention of new apparatus for their production.

The most novel and interesting application of electricity mentioned by the author is its use in connection with electro-magnets for hoisting purposes. He illustrated one case in which a load of 9,200 lbs. was picked up by an electromagnet weighing but 1,000 lbs., energized by a current of 4.9 ampères and 216 volts pressure. "Such a device," said he, "may often be used to great advantage in handling pig iron, castings, boiler plates, &c., owing to the speed with which the operation of picking up and letting go may be accomplished. A simple make and break switch answers for a controlling device, and may be located either on the magnet itself, or any desired point. By a simple device, the quantity of current, and proportional strength of the magnet, may be varied at will by the operator, so that in handling small pieces, such as bolts, rivets, fittings, &c., only the desired amount may be lifted."

This is a field for electricity, which is as yet practically untouched. While for lifting very heavy weights some more secure fastening than the attractive power of a magnet will naturally be preferred, for handling iron in small pieces, as suggested by the author, there seems to be promise of an efficient substitute for hand labor. In the handling of iron ore, for example, from stock piles, which no power shovel will penetrate, or in taking it out from the hold of a steamer, the chance that an electro-magnet may greatly expedite and economize the work now done by an army of hand shovelers seems one well worth examination.

The Sewall Steam Hose Coupler.

It does not take a very long memory to recall how in the early days of steam car heating difficulties almost without number were claimed to lie in the way of any general use of steam heat for railway cars. Many of these proved to be imaginary; but one difficulty which was long a real obstacle to the extension of steam heating was the want of a uniform and satisfactory coupler between the cars.

For a long time the contest between hose and all-metal connections between the cars seemed a doubtful one; but the course of events seems to have pretty well settled that, for the present at least, the all-metal connection stands no chance in the competition with hose.

In our statistics of the progress of steam car heating, published in our issue of June 7, 1890, it was shown that the Sewall coupler, which was first used on the Maine Central R. R. in 1887, was coming into extensive use in New England and vicinity and on several prominent Western roads. Since that time its progress has been rapid, as we have from time to time noted; and the Consolidated Car-Heating Co., which controls it, informs us that it is now in use on 88 railways, controlling 8,922 passenger cars and having a total extent of 45,941 miles.

Its makers claim it to be the original straight-port and "insulated" steam coupler, the passage for steam being practically straight, as seen in the sectional view, Fig. 3, and unobstructed by strainers, springs, diaphragms, gasket retainers, or acute angles. Condensation is obstructed by "insulating" the hose nipple (or steam tube) by a dead air space, completely surrounding the steam tube within the coupler head.

FIG. 1.

FIG. 2.

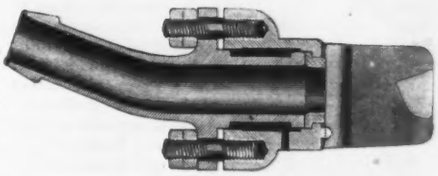


FIG. 3.

FIG. 4.

FIG. 5.

THE SEWALL COUPLER FOR STEAM CAR HEATING.

The accompanying cuts illustrate the coupler and show the simplicity of its construction. All the metallic parts are of malleable or wrought iron or steel.

On the coupler head are placed a tooth and space in proper position (shown in *H* and *I* in Fig. 1) to serve the double purpose of a guide for the interlocking devices when being coupled and also to retain the coupler heads in proper relation while uncoupling. The locking features are constructed upon carefully calculated epicycloidal curves, thereby drawing the gaskets together in a direct line after contact. The center line of pressure exactly coincides with the center line through the locking devices, and hence gravity tightens the faces. That the coupler is absolutely automatic in uncoupling is due to the curvature of the hose nipple (shown in Fig. 3), the center line of draft being brought above the center line of pressure as soon as the hose begins to approach a horizontal position. The gaskets are composed of peculiarly treated rubber, and have sufficient elasticity and strength to form a perfect and durable steam joint. The gasket is tightly pressed upon the inner face of the coupler head by the hose nipple being forced against it, and is held rigidly in place by studs and nuts (shown in Fig. 3). A new gasket is readily put in place when occasion requires.

The parts of the Sewall coupler are but five—the coupler head, the nipple, the gasket, the studs and the nuts. It has no movable parts, and hence no places for wear; and is therefore claimed to be more durable than any other coupler, and always steam tight.

It hangs below the air brake coupling, so that any drip cannot fall on that and freeze it tight. It couples easily and uncouples automatically.

The standard measurements adopted for the application of the Sewall Coupler throughout the United States and Canada are as follows:

Train-pipe to terminate on right-hand side as one looks out of the car and at a distance of 13 ins. from the buffer face. Termination of train-pipe to be also 12 ins. to the right of the center line of the car and 32 ins. from the top of rail. Hose to be 23 ins. long. Support chains, from center plate to center of hook on standard passenger cars, to be 34 ins. long. Train-pipe to be of 1¼ ins. pipe, terminating with 1¼ in., standard thread, 45° ell. This to be screwed on train-pipe so as to point slightly toward center line of car.

The careful observance of these standards has made possible the present wide interchange of several thousand cars equipped with the Sewall coupler.

The First Electric Tramway on the Overhead System in England.

[FROM A LONDON CORRESPONDENT.]

The inauguration which took place on Oct. 29 of the Roundhay Electric Tramway in Leeds was an event of considerable importance in the history of electric traction in the United Kingdom. The Board of Trade, by virtue of the electric lighting acts and their amendments, prohibits the erection of overhead wires; but in special cases this regulation is relaxed, provided the consent of the local authority is first given. The obtaining of the permission of the latter to the putting up of aerial wires is rather a difficult matter, and until last week the only two tramways operated from aerial conductors on the European continent were in Bremen and Halle, Germany, the Thomson-Houston system being used in the former town. [This statement is somewhat in error. There is at least one other overhead line in Europe on the north shore of Lake Geneva, between Vevey and Chillon, which latter is a very successful line with one striking novelty, viz., that instead of a trolley, a short contact rod is used which *slides* inside of a hollow pipe-shaped conductor slotted at the bottom. It seems to work very well.—ED.] Now, however, England boasts of one line on this system. The line was leased to Mr. GRAFF BAKER on May 15 last for a period terminating Oct. 31, 1892, and for the purpose of installing the Thomson-Houston system which had been accepted by the Highways and Tramways Committee of Leeds Town Council.

The total length of tramway at present worked electrically is 5½ miles, comprising 2 miles of double line on Roundhay Road, containing gradients of about 5% for a distance of a ½ mile and 1½ miles of single line, with passing places, and having a gradient of 3.57% for ¾ mile. There is a soft drawn copper wire, No. 0 B. W. G. 0.34 in., laid between each pair of rails upon a concrete bed, forming the return to the dynamo terminals. This return wire is joined twice to each rail by short lengths of No. 7 B. W. G. soft drawn copper wire. These lengths pass through drilled holes in the web of the rails and are securely keyed in place by small channel pins.

The current is conveyed to to the overhead line and to the motors upon the cars by a No. 0 B. W. G. hard drawn copper "trolley wire." This wire is supported over the center of the track by means of insulators attached to "span wires" extending from standards placed on the curbing of the footpath. The span wires are No. 5 B. W. G. galvanized steel wires securely fastened to insulators at the top of the standards. These are formed of three lengths of mild steel tubes, fitted into each other, and standing 6 ft. in a concrete foundation. The height of the posts above the ground level is 21½ ft. The diameter at the base is 6 ins. and at the top 4 ins. There are three "feeders" to the overhead line, carried on brackets placed on the standards.

The power station is 85 ft. by 36 ft. The boiler is of Babcock & Wilcox type of 192 HP. It is fitted with feed water heater, mechanical stoker, &c. Space is available for the erection of a second boiler if required. The engine room is divided from the boiler room by a brick partition wall, and contains a MacIntosh & Seymour single cylinder high speed engine belted to a Thomson-Houston dynamo of 80 HP. The engine works at 100 lbs. pressure and runs at 200 revolutions. The dynamo has an output of 206 ampères at 300 volts. A second dynamo of the same power is also installed. The switchboard, which is arranged on one side of the engine room, is fitted with two Thomson-Houston ammeters, two automatic circuit breakers, one Western voltmeter, and the necessary switches, rheostats, &c.

The car depot contains four tracks with accommodation for 12 cars. A pit, 30 ft. by 40 ft., allows of inspection or cleaning of cars simultaneously. The present equipment consists of six cars of elegant design and finish, and were made by Messrs. John Stephenson & Co., Lim., of New York. They are each fitted with two single reduction Thomson-Houston motors of 15 HP. each, geared to either axle. The motors are series wound and coupled in parallel; they are suspended directly on the axle and geared with cut steel gearing. The ratio of reduction in the speed is about 4½ to 1. The gears run in oil. The total weight of the fully equipped car without passengers is 6 tons. The cars have no "imperial" or upper deck, are built to carry 22 persons, and are lighted by 5 incandescent lamps. The trolley bar is of the usual construction. The current

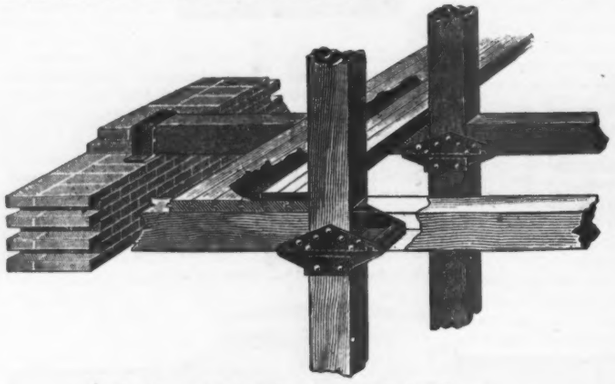
is conveyed by wires to the motors, through the wheels of the cars to the rails and return wire to the dynamo at the generating station. The regulation of the current is effected by a rheostat placed under the control of the driver.

On the day of inauguration, the Leeds municipality, representatives of other local authorities, tramway directors and others were conveyed over the whole length of the line in the six cars running simultaneously. The speed is 8 miles an hour. When starting on a gradient, a little sparking was noticeable both between the rails and the wheels, and between the trolley wheel and the trolley wire; but this is no disadvantage. The opening ceremony attracted many thousand people to see the running of the cars.

Anchoring Beams in Building Construction

The last issue of *The Franklin Institute Journal* contains an illustrated description of the Goetz-Mitchell system of anchoring beams in building construction, and the committee on science and the arts, of the Institute, recommends the award of the John Scott Legacy Medal and Premium to the inventors, Messrs. MANSELL MITCHELL and HENRY A. GOETZ.

The purpose of the invention is to afford a safe anchorage to the ends of timber beams, and yet to prevent the tearing out of partition walls in case of the fall of the beam by reason of fire or failure of center supports. The older form of strap-iron bolted to the top of the beam and anchored in the wall by a T-end to the strap, failed as a support to the base of beam and inevitably tore out the wall when the beam failed. The cast iron wall plates used in factory construction in New England are a vast improvement upon this earlier practice, but the committee expresses the opinion that the Goetz-Mitchell system is "a decided improvement upon this again."



The Goetz-Mitchell System of Anchoring Beams.

As shown in the cut used, the beam is either flared or rounded toward the lower inside bearing and is fitted into cast iron sockets and held there by a notch in the bottom of the beam and a corresponding flange in the casting. The fall of the beam from this inclosing box can exert no leverage on the wall to destroy or shatter it. The cut also shows pillar connections and the double floor, with tarred paper between, now in use in factory construction.

Irrigation in India: Its Value and Necessity.

BY HERBERT M. WILSON, M. AM. SOC. C. E.

In view of the interest which has recently developed in the subject of irrigation in this country, it will be well to observe what benefits have been derived financially and otherwise from the irrigation works which have been in active operation in India during the past century, and also to note what Indian and English statesmen and engineers have to say on the subject of the extension of irrigation in that country. Because of the similarities of the climates and the conditions under which irrigation works are operated in America and India, some useful lessons may be drawn from these comparisons. The conditions of utilization of the waters in autumn irrigation in India, and in summer irrigation in the United States are quite similar, as the autumn crop in India is cultivated under circumstances almost identical with those under which our ordinary summer crops are grown in the arid region.

The Indian financier divides the irrigation works into two great classes, called major and minor works. Major works are generally those of more importance from an engineering point of view, and have been in some cases almost entirely constructed by the British Government, while the minor works are of smaller pretensions, and are in many cases modifications or improvements of existing ancient irrigating systems. A portion of the major works which are constructed from capital provided out of the general revenues of India, are styled "Protective Works," while "Productive Works" are usually constructed from capital which has been provided from borrowed money, and it is expected that a sufficient profit will be realized from their operation to pay interest on the money borrowed for their construction. Many minor works are productive works.

In general, protective works are constructed as a protection against famines, and they act in the amelioration of these in two ways: Firstly, they are constructed during famine times in order to give employment to the people and thus furnish them money and food for their sustenance; and secondly, after their construction they are expected to furnish sufficient water for irrigation purposes to render them a protection against future famines. The majority of these famine protective works consist of storage reservoirs constructed in the more dry and arid portions of India. The reason of the success of the greater productive works of northern India is two-fold. Firstly, these works are constructed in a country similar to that of the western United States, so barren and devoid of water that nobody could live there or produce crops of any sort until canals had been constructed and water provided for purposes of irrigation. Accordingly, all those who immigrated to the neighborhood of these canals were at once compelled to use and pay for the water, otherwise they would have been unable to raise crops. It is owing to the fact that these works have been able to do their full duty, and that the total amount of water furnished by them has been in constant demand, that these works have been interest-paying. On the contrary, the protective works, which have usually proven financial failures, have been constructed in sections of the country where in ordinary years the precipitation has been sufficient to produce good crops, but where during occasional years of drouth the crops suffer for lack of water, and it is then, only, that the irrigation works are called upon. Such works only being utilized occasionally, produce only moderate returns during occasional years. Were these works constructed in a region less inhabited and lacking sufficient precipitation to raise crops, they would, doubtless, then do constant duty, and it might reasonably be expected that they would become productive works. In some few cases, such as those of the Sidhnai Canal in the Punjab and the Betwa Canal and Reservoir System of the Northwest, works which were originally constructed as protective works, have received such a constant demand for their waters that they are now productive, returning moderate interest on the capital outlay.

Anywhere in our arid West where irrigation works may be constructed it is reasonably to be supposed, judging from analogy, that when a sufficient immigration may be induced to settle, these works will be constantly called upon to furnish all the water which they can provide and if properly and carefully planned and estimated for, should return fair interest on the original outlay. It is only semi-humid regions such as western Kansas, Dakota, Nebraska and Oklahoma that have been subject to famines. These are frequently and constantly recurring during periods of a few years and are the results of the country having been occupied by settlers during periods of fair rainfall when they expended time and money on the improvement of their homes. Following these good years came a season or two of minimum rainfall, when the crops were parched for lack of water. It is only because of the increased transportation facilities in our West and the extensive charities undertaken by the Government and people that the settlers in that portion of our country have been saved from famine and death. It is in such regions as these in India that the Government has devoted the most time, attention and money to the construction of irrigation works as a means of protection against such losses, and extensive and convincing arguments have been brought to prove that money expended in such protective works is money saved to the Government from the charity which must be bestowed, or losses which fall upon the people as a whole or individually.

The low price paid to labor in India is the argument generally used in America to prove that similar profitable returns from irrigation enterprises in this country cannot necessarily be anticipated, as the cost of construction with us would be proportionately so much greater as to demand much higher return from the use of water in order to pay a corresponding rate of interest. It is not improbable that with the increased amount of work done by an American laborer as compared with that of a Hindoo coolie, and with the aid of our many mechanical operations, the discrepancy in cost is not so great. Moreover, returns derived from irrigation works in the two countries are more nearly equalized from the fact that we can impose a much higher tax for the use of water than it is possible to demand of the poor farmers in India where from two to five acres support a large family. The apparent low cost of Indian labor is at first glance against this argument. Women, children and men are engaged alike in the construction of all works. As common laborers women and children receive about 4 cents per day, and men from 8 to 10 cts. Skilled masons and machinists receive from 18 to 22 cts. per day, and carpenters and blacksmiths nearly the same.

In the interior towns of the Bombay Presidency contract prices are about as follows: At the Bhatgur dam uncoursed rubble masonry costs $1.75 per cu. yd., while at Tansa dam it costs $2.50 per cu. yd. In the Northwest provinces earth excavation in deep canal cuts costs 6¾ cts. per cu. yd., while surface excavations costs 2½ cts. In the Punjab, according to the revenue reports, the water rate charged per acre irrigated is from $.70 to $1.15. In Bombay according to the revenue report of 1889, the water rate derived was $1.15 per acre irrigated and ranged from 35 cts. to $3.00, the latter figure being abnormal and paid for the irrigation of sugar cane crops which require an enormous amount of water in their cultivation. Against these prices in the central arid regions of America we are able to charge a revenue of from $1.50 to $3 per acre, which is equivalent for a duty of 80 acres per second-foot to from $120 to $240 per second foot utilized. In California and other portions of the country where water is scarce and the crops valuable the rate is usually many times higher than the above. In the Province of Sind in the Upper Indus Valley, including the southern Punjab, there is an enormous and thirsty waste of sandy desert where the annual precipitation is always below 10 ins., even falling as low as 3 or 4 ins. There nothing can be grown without the aid of irrigation and the entire area which is under cultivation and the population supported thereby are entirely dependent on irrigation. The works in that region are chiefly inundation canals with a few perennial canals mostly taken from the Indus River. In the Sind alone are over 1,500,000 acres under cultivation and yielding an annual revenue of about $1,600,000. In Bombay and the Northwest Provinces nearly double the population is now sustained that was supported previous to the introduction of modern irrigation works. According to Col. BAIRD SMITH the whole of the region irrigated by the Eastern Jumna Canal would have been devastated by the famine of 1837-8 without the aid of the irrigation which that canal afforded. With its aid the population were comfortably supported, and the gross revenue derived from the use of the water was $2,445,000, of which the Government received as net yearly income $250,000, and this shortly after the completion of this work. In the

same years the united Eastern and Western Jumna canals were estimated to have saved property to the value of $10,000,000, and as a result of this showing the British Government shortly afterward began the construction of the great Ganges canal and other similar works. From the report of Major BAKER, R. E., it appears from actual measurements made on the Western Jumna canal, in 1838, that the gross value of crops on land irrigated by that canal was $7,500,000, of which $750,000 was paid to the Government as land and water rent; the remainder aided to feed and support the inhabitants of 500 villages during a period of devastating famine. Without irrigation this land would during that drought have been totally unproductive.

As an indication of the increased revenue derived from the use of water and the capability of the soil to pay that increase, it appears that in the Presidency of Madras the rate of assessment in the tank region is about $2.30 per acre on irrigated land against $.55 per acre on land not irrigated. It is difficult to show in a fully satisfactory manner what has been the actual result of the irrigation works of India as financial undertakings. The figures given convey little idea of the actual benefit to the country at large and do not give the full revenue derived from the canals, as much of this is collected indirectly with the land revenue, that is the land tax which forms nearly half of the total revenue of the Indian Government.

Another difficulty in reviewing the financial results of Indian irrigation works is found in the fact that, in several cases, capital shown by the Government accounts does not include the value of the old native works upon which the British undertakings were founded. Recognizing these difficulties, Major General DICKENS presented to the select committee on public works a statement, of which the following is a summary, which was given as the nearest approximate to the truth that could be obtained. This statement was for the year 1875-76, only, and no allowance was made for the value of old native works, which General DICKENS stated did not exceed $2,500,000. The total expenditure to date was $77,500,000; the total receipts were $6,150,000, and the working expenses were $2,000,000. This shows that the irrigation works of India taken altogether paid at that time a revenue direct and indirect of 5⅛% to the state; this includes some works which were only partially in operation. General DICKENS anticipated that, when in full operation, they would eventually pay from 6 to 7 %.

As an indication of the time which must necessarily expire after a canal work is opened and before it is doing its full duty and returning its full revenue, the Great Ganges Canal was 14 years in operation before it paid 4% on its simple capital, and Colonel CROFTON, the late Inspector General of Irrigation in India, appears to think that 10 years is by no means an unreasonable time to elapse after an irrigation work has been put in operation before it can pay interest on its cost. Gen. R. STRACHEY in 1865 gave it as his opinion that it was not likely that 5% even would be realized in 10 years on a capital stock on any but the smallest irrigation works, while Col. BAIRD SMITH took it for granted in reporting on the proposed Soane Canal that the works would not be self-supporting for 16 years after they had been opened for irrigation.

The following quotations are adopted in full from the reports of the select committee, appointed in 1888 by the British Government to report on the measures of protection and prevention of famine. This report must bear great weight, owing to the high character of the members of the committee, both as engineers and men of experience in the construction and management of irrigation works and as statesmen of broad views, whose integrity cannot be doubted. This committee consisted of Gen. RICHARD STRACHEY, JAMES CAIRD, H. S. CUNNINGHAM, H. E. SULLIVAN and J. P. PEILE. Their remarks relative to the value of irrigation works were as follows:

> It is not only in seasons of drought and famine that irrigation works are of value. In seasons of average rainfall they are of great service and a source of great wealth, giving certainty to all agricultural operations, increasing the outturn per acre of the crops and enabling more valuable descriptions of crops to be grown. The following instances may be quoted from the mass of evidence before the commission:
>
> The outlay on completed canals in the Punjab up to the close of 1877-78 had been $11,300,000. The total area irrigated by them was $1,324 000 acres. The value of food grains raised on two works, the Western Jumna and the Bari Doab canals was $14,400,000. It may without exaggeration be reckoned that one-half of these crops would have perished if unwatered or would not have been raised at all if the canals had been absent, so that in that one year alone the wealth of the Punjab was increased by these two canals by $7,200,000, an amount equal to about two-thirds the cost of the works, and but for the protection they afforded the government would have lost heavily from the necessity of remitting revenue and otherwise providing for famine relief. The net revenue for the year in the Punjab was only $310,000, being about 5½% on the capital outlay on works in operation, a result which obviously supplies a wholly inadequate test of their value to the country.
>
> Up to the year 1878 the capital outlay on canals completed in the Northwest provinces had been $21,800,000. The area irrigated that year was 1,461,000 acres, the value of the crops raised on which was estimated at $30,000,000. Half of the area irrigated was occupied by autumn crops which but for irrigation must have been wholly lost, and it may be safely said that the wealth of these provinces was consequently increased by $15,000,000, so that three-fourths of the entire first cost of the works was thus repaid to the country in that same year. The net revenue to the government from irrigation in these provinces was $1,550,000, or about 7⅛% on the whole capital outlay of $28 750,000, of which about $6,250,000 was still unproductive.
>
> The results of irrigation are not so favorable in Bengal and Behar as in the above two provinces, chiefly because irrigation is there less necessary since the rainfall is more abundant. There is sufficient evidence of its value in Madras. The three great deltaic systems of irrigation, the Godaveri, the Kistna and the Cauveri, yield direct returns of 8, 8 and 31%, respectively, on the capital spent on them. During the year 1876-7, a year when every unirrigated district was importing a large part of the food of its population, the value of rice produced in the deltas of the Godaveri and Kistna rivers is calculated at the prices then prevailing to have been not less than $25,000,000. The ordinary rental of land in northern India is doubled by irrigation, while in 11 districts of Madras the average rental rises from 46 cts. to $1.70 per acre. In considering this question it should be borne in mind that there are other causes of financial ill success of irrigation works—the one temporary, the other permanent. In the one case the works may fail to pay for a time because of the slowness with which the people adapt themselves to the new system of cultivation, a difficulty which arises in almost every new work or because of errors in the details of the scheme which experience detects and which are gradually remedied. In the other case the failure may be due to the inherent defects of the scheme and to the fact that the water costs more than it is worth. In the former case there may be reason to expect that the water will be eventually fully utilized and the deficit be converted into a surplus, though the accumulated excess charges during a series of years may amount to a large sum which receipts will only gradually wipe out. In the latter case, though there may be room for improvement and economy in the distribution and use of the water, it may be impossible to ever realize a surplus.

According to the same authorities the net income of the whole works in operation in British India was in the year, 1879-80, $5,830,000, which amounts within a very small fraction of 6% of the whole capital, including about $16,250,000 spent on works not yet brought into operation. If this part of the outlay be excluded the income is found to be more than 7% on the capital actually utilized.*

The following statement of the water rents derived from the use of the Western Jumna Canal in the Punjab between the years 1820 and 1850 will give a fair idea of the rapidity with which the income from the use of irrigation works increases. In 1820 the water revenue was $420 per annum; in 1830 it was $28,800; in 1840 it was $112,900. On the Eastern Jumna canals in the Northwest Provinces the water revenue was in 1830 $3,000 per annum. In 1840 it was $29,300 per annum, and in 1845 it was $48,200 per annum.†

In 1888 the area of British India was 1,378,044 square miles, exclusive of British Burmah; of this 1,007,720 square miles was British territory, the remainder being included within native states under the British protectorate. The population of the British territory was 208,733,350 and of the native states 60,684,378, making the total population 269,477,728. The following table shows the area cultivated and irrigated in the various provinces of India during 1888.

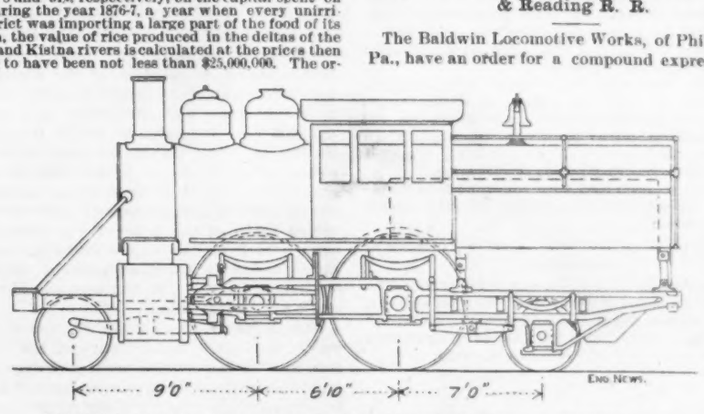
AREAS CULTIVATED AND IRRIGATED.

	Acres cultivated.	Acres irrigated.
Madras	25,186,000	6 234,000
Bombay	27,056,000	2,418,000
Northwest Provinces	29,764,000	6,508,000
Punjab	22,798,000	6,091,000
Oudh	11,268,000	2,468,000
Central Provinces	14,984,000	516,000
Others	scattering	scattering
Total	144,006,000	24,936,000

Of this area rice cultivation occupied 24,238,600 acres; wheat, 19,886,600 acres; other food grains, 73,992,400 acres; cotton, 9,042,300 acres; oil seeds, 7,299,500 acres. The remainder being cultivated in tea, indigo, poppy, vegetables, &c.

Compound Express Locomotive; Philadelphia & Reading R. R.

The Baldwin Locomotive Works, of Philadelphia, Pa., have an order for a compound express engine



BALDWIN COMPOUND LOCOMOTIVE FOR PHILADELPHIA & READING R. R.

for the Philadelphia & Reading R. R. It will be on the Vauclain four-cylinder compound system, already illustrated in ENGINEERING NEWS of May 3, 1890, Sept. 6-13, 1890, and other issues. It has been applied already to a very large number of engines. The general arrangement of the engine is shown by the accompanying outline diagram. It has a two-wheel or Bissell leading truck, four driving wheels 6 ft. 6 ins. diameter, and a pair of small trailing wheels under the Wootten firebox. The leading dimensions and particulars of the engine are as follows:

Cylinders, h. p.	13x24 ins.
" l. p.	22x24 ins.
Diam. of driving wheels	6 ft. 6 ins.
" truck wheels	4.0
" boiler	4.9½
Form of boiler	straight
" firebox	Wootten patent
Size of firebox	114x96⅝ ins.
Tubes, number	324
" diam.	1¾ ins.
" length	10 ft. 6 ins.
Heating surface, firebox and combustion chamber	173.46 sq. ft.
" " tubes	1,267.75 " "
" " total	1,435.21 " "
Grate area	76.6 " "
Boiler pressure	175 lbs. per sq. in.
Wheel-base, driving	6 ft. 10 ins.
" rigid	13.10
" total	23.1
Weight on driving wheels (about)	76,000 lbs.
" " leading truck "	19,000 "
" " trailing " "	25,000 "
" total (about)	120,000 "
" of tender, loaded (about)	92,000 "
Tender truck wheels, diam.	2 ft. 9 ins.
Capacity of tender, coal	5½ tons.
" " " water	4,000 galls.
Brake fitting	Westinghouse automatic.

Test of a Pulsometer.

Every engineer is familiar with the fact that for many uses the steam vacuum pump has proved itself a most economical and efficient machine for raising water. Some of the manufacturers of this type of pump, however, are not content with this but claim their machines to be actually able to do more work per pound of coal consumed than an ordinary piston pump. Some of the[se] indeed, display testimonials from users of th[e] pumps sup-

*Report of the Indian Famine Commission, Part 2, London. 1880.

†"Italian Irrigation," R. BAIRD SMITH, F. G. S., London 1855, Vol. 1, 318-340.

porting this claim. Very few careful tests of this type of pump are recorded; and the paper by Prof. DE VOLSON WOOD, of Stevens Institute, read at this week's meeting of the American Society of Mechanical Engineers is therefore of considerable interest. We print it practically in full as follows:

The pulsometer tested was one taken from the ordinary stock of machines of the Pulsometer Steam Pump Co., and known by them as the "New Pulsometer No. 6." It had a 3½ in. suction pipe and discharge pipe, stood 49 ins. high and weighed 695 lbs. The object of the test was to determine the duty and efficiency as a lifting pump under varying conditions. It was run as nearly as could be under the actual conditions in practice in regard to throttling. The test was made at Stevens Institute, by C. G. ATWATER and CHAS. B. HODGES, for their thesis work for 1891.

The suction and delivery pipes were each 4 ins. diam. Holes were drilled into the pipes just before entering and just after leaving the pump for attachments of pressure gages and insertion of mercury wells for determining the temperature.

The return pipe for receiving the discharged water was of such construction as to avoid siphoning. The water was returned to a tank from which it passed through a meter to the large tank from which the water was originally pumped. An even temperature was maintained in the large tank by admitting cold water and providing for an overflow of the surplus amount.

The steam pipe was 1 in. in diam., with a throttle placed about 2 ft. from the pump, and pressure gages placed on both sides of the throttle, and a mercury well and thermometer placed beyond the throttle. Thus a definite knowledge of the steam was obtained. The wire drawing due to throttling caused superheating.

The pounds of steam used were computed from the increase of temperature of the water in passing through the pump. We have:

$$\textit{Lbs. of steam} \times \textit{loss of heat} = \textit{lbs. of water} \times \textit{increase of temperature},$$

from which the pounds of steam may be computed. The loss of heat in a pound of steam equals the total heat in a pound of saturated steam as found from "steam tables" for the given pressure, plus the heat of superheating, minus the temperature of the discharged water; or

$$\text{Lbs. of steam} = \frac{\textit{Lbs. water} \times \textit{increase of temp.}}{H - 0.48t - T.}$$

This process neglects the weight of the steam condensed by the water, but the error in these tests does not exceed ½ of 1%.

The work was computed by means of the pressure gages and the quantity of water as measured by the meter. The gages were 3 ft. apart vertically, and this amount was added to the head of the suction. This method determined the work done by the pump, as it eliminated the effect of friction and losses due to bends, or, in short, any losses in and along the pipes.

The efficiency is the ratio of the work done to the heat absorbed, both measured in foot-pounds.

Test 1 gives:

Average rise of temperature of water	4.47°
Average degrees of superheating	13.1°
Total heat of steam above 79.62°	1,118.67°
Water pumped, lbs.	404,786
Heat absorbed, B. T. U.	1,815,127
Mech. equivalent of heat absorbed, ft.-lbs.	1,412,169,047
Steam used by temp. test, lbs.	1,617
Height of lift, actual, ft.	25 3
Dynamic head by gage on lift, ft.	29.9
Height of suction, actual, ft.	7.5
Reading of vacuum gage on suction, ft.	12.26
Total work as determined by gages, u	16,996,886
Efficiency, $u \div$ heat absorbed	.012
Duty = foot-lbs per 10 lbs. steam	105,114

The other three tests were conducted in a similar manner. The results for the four tests are given in the following table:

Of the two tests having the highest lift (54.05 ft.), that was more efficient which had the smaller suction (12.26 ft.), and this was also the most efficient of the four tests. But, on the other hand, the other two tests having the same lift (29.9 ft), that was the more efficient which had the *greater* suction (19.67 ft.), so that no law in this regard was established. The pressures used, 19, 30, 43.8, 26.1, follow the order of magnitude of the total heads, but are not proportional thereto. No attempt was made to determine what pressure would give the best efficiency for any particular head, and there is a field for experiment in this particular. The pressure used was entrusted to a practical runner, and he judged that when the pump was running regularly and well, the pressure then existing was the proper one. It is peculiar that in the first test a pressure of 19 lbs. of steam should produce a greater number of strokes and pump over 50% more water than 23.1 lbs. in the fourth experiment, the lift being the same.

To put the results of these tests in units a little more familiar, let us suppose the evaporative duty of the boiler to be 8 lbs. of water per lb. of coal; then in test No. 1 the pulsometer used 23½ lbs. of coal per horse power per hour. In test 2, 18.5 lbs. of coal; in test 3, 22.4 lbs. of coal, and in test 4, 20.6 lbs. of coal were used per horse power hour.

This, while of course a low duty compared with that of a piston pump, shows a great advance over the duty of pulsometers in use a score of years ago. In a paper by J. FOSTER FLAGG before the American Society of Civil Engineers in 1876, several experiments on a steam vacuum pump were recorded with results of from 39.78 to 53.06 lbs. of coal consumed per horse power per hour. The average of four tests was about 41 lbs. per horse power hour; and Mr. FLAGG concluded that "with lifts similar to those tried in the experiments a consumption much less than 40 lbs. of coal to the horse power can hardly be expected." The above test at Stevens Institute, therefore, seems to show that a great improvement has been made in this class of pumping machinery.

Africa and the European Powers.

It is common knowledge that the current of civilization which has wrought such wonders in Europe, America, Australia and even Asia, has, until recent years, left the great tropical continent of Africa practically untouched. It is mainly within the past decade and still more prominently within the past seven years, or since the Berlin Conference of 1884-5, that the attention of the civilized world has been strongly directed toward Africa as a field for profitable colonization and enterprise, and the last continent in which the nations of Europe will ever be able to scramble for the possession of territory. It is true that the continent has long been bordered by scattered and unprosperous colonies of Europeans, and that the temperate region south of the tropic of Capricorn was long ago occupied by English and Dutch emigrants; but the extension of European political influence into the remote interior has not been considered worth while until a recent date.

Now, however, the African continent has been pretty thoroughly divided up; and the "sphere of influence" of each of the European powers have been quite accurately defined, in most cases by agreement between the diplomatists of the nations interested. The country which should now desire to secure a slice of Africa will have to content itself with the unappropriated portion in the Sahara and Soudan, which is still to be had for the taking, but which is no very tempting possession, even if its taking were an easy matter.

After an extended and unavailing search for a correct map showing the manner in which Africa has been thus divided up among the various powers, we have compiled the accompanying one from the data contained in the "Statesman's Year Book" for 1891, designating the "spheres of influence" of each nation by a special hatching.

In the November number of *Harper's Magazine* there was published a valuable paper by ARTHUR SILVA WHITE, advocating the co-operation of the various European powers with each other in the extension of the reign of law and order in Africa. Mr. WHITE is Secretary to the Royal Scottish Geographical Society and author of "The Development of Africa." Mr. WHITE argues that the chief motive for the establishment of European colonies and the extension of European political influence in Africa is that it will pay a financial profit. The general knowledge of Africa has now reached such a stage that a fair estimate of the comparative value of different sections to the nations controlling them can be made. The author proceeds then to make such an estimate, the result of which is shown on the accompanying map, Fig. 2.

The scheme on which the map is worked out is to take into consideration so far as possible each element affecting injuriously or beneficially the value of the various sections to the European power controlling it, assigning to each a certain numerical value as follows:

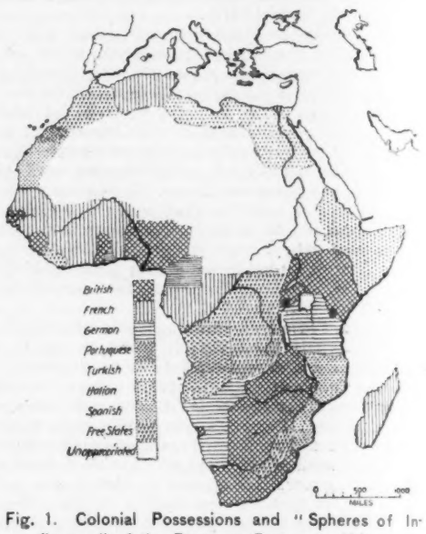


Fig. 1. Colonial Possessions and "Spheres of Influence" of the European Powers in Africa.

	Percentage of Aggregate Value.
A. CLIMATIC PHENOMENA—	
Temperature, 10; Range of temperature and relative humidity, 5; Absence of malaria, 5	20
B. NATURAL COMMUNICATIONS	10
C. NATURAL RESOURCES—	
Animal (including elephants or ivory) and vegetable, 10; Mineral, 10	20
D. EXTERIOR TRADE AND COMMERCE—	
Chiefly volume of trade (exports and imports)	10
E. INDIGENOUS POLITICAL CONDITIONS—	
Religion or faith, 5; Native culture, 10; Relations with Europe, 5	20
F. FOREIGN POLITICAL CONDITIONS—	
Character and extent of European domination or settlement, 10; Capacity for development of European institutions, 10	20
Highest value = 100	

Of course the estimates obtained in this manner had to be considerably modified in applying them to special localities. The boundary lines on the map are in fact likened by the author to contour lines, their approach to each other denoting an abrupt

DATA AND RESULTS.	NUMBER OF TEST. 1	2	3	4
Strokes per minute	71	60	57	64
Steam pressure in pipe before throttling	114	110	127	104.3
Steam pressure in pipe after throttling	19	30	43.8	26.1
Steam temp after throttling, deg. Fahr	270.4	277	309.0	270.1
Steam, amount of superheating, deg. Fahr	3.1	3.4	17.4	1.4
Steam, total heat above that of water, B. T. U.	1,118.67	1,112.44	1,127	1,121.2
Steam used as determined from temp., lbs	1,617	931	1,518	1,019.9
Water pumped, lbs	404,786	186,362	228,425	248,053
Water temp. before entering pump, deg. Fahr	75.15	80.6	76 3	79.25
Water temp. after leaving pump, deg. Fahr	79 62	86.1	83.79	74.80
Water temp., rise of	4.47	5.5	7.49	4.55
Water, heat absorbed, B. T. U.	1,815,127	1,024,993	1,704,498	1,143,527
Water, head by gage on lift, ft	29.90	54.05	54.05	29.90
Water, head by gage on suction	12.26	12..6	19.67	19.67
Water, head by gage, total (H)	42.16	66.31	73.72	49.57
Water, head by measure on lift	25.30	50.30	50.3	25.30
Water, head by measure on suction	7.5	7.50	16.3	16.30
Water, head by measure, total (h)	32.8	57.80	66.6	41.60
Coefficient of friction of plant (h) ÷ (H)	0.777	0.877	0.911	0.839
Total work as per gages	16,966,886	122,335,940	16,795,192	12,275,923
Efficiency of pulsometer	0.012	0.0155	0.0126	0.0138
Efficiency of plant exclusive of boiler	0.0093	0.0136	0.0115	0.0116
Efficiency of plant if that of boiler be 0.7	0.0065	0.0095	0 0080	0.0081
Duty of pump per 100 lbs. coal if 1 lb. evaporates 8 lbs. water	8,409,120	10,712,800	8,817,200	9,029,040
Duty if 1 lb. evaporates 10 lbs. water	10,511,400	13,391,000	11,059,000	12,036,300

change from a valuable region to one difficult of colonization or control. It will be seen that the regions of highest value are those contiguous to the coast and to the great river highways leading to the interior, while the lowest valued areas are those remote from communication or over which climatic or political conditions are in the highest degree inimical to their development. The high value of South Africa is due to its relatively healthy climate, its organized political institutions, its strong base on the coast, and its rich natural resources. The low value of the Upper Nile region is of course due to its unfortunate political condition.

In the map as published in *Harper's Magazine*, no attempt was made to proportion the intensity of the shading to the relative values of the areas covered; and the areas of greatest and of least value were only distinguishable by a study of the hatchings. We have, therefore, redrawn the maps, correcting this error so evident to an engineer, and shading each area in proportion to its value.

Taking the two maps in connection with each other, the showing is of the greatest interest. England has not only appropriated the largest area of any nation (with the exception of France), but has managed in almost every case to secure the areas of greatest present and prospective value. France has a somewhat larger slice, including its Madagascar possession; but a great portion of it is included in the Sahara and Soudan, in districts whose climate and inhabitants are so hostile that the country is yet to be thoroughly explored.

The little kingdom of Portugal has secured a very good share in the division, and its lands are very well located. Its neighbor, Spain, has practically nothing in comparison. The only large tract which it controls is the strip along the coast southwest of Morocco, and its dominion over this is a very nominal one.

Germany has four considerable possessions in Africa, and while they are by no means comparable in value with the British territory, they are fairly located. Italy has secured Abyssinia and considerable adjoining territory; some portions along the sea coast are of considerable value. The following table from the "Statesman's Year Book," with our map, shows pretty well how Africa has been divided:

	Area.	Population.	Inhab. to a sq. mile.
British Guinea	375,370	22,632,000	60
British So. Africa	968,570	3,794,000	4
British E. Africa	1,097,367	13,015,000	12
Total British, with islands, &c	2,462,436	30,836,600	16
French Africa :			
Algeria	184,500	3,820,000	21
Sahara	1,568,000	1,120,000	0.7
Soudan	475,500	8,400,000	18
French Congo	220,000	2,500,000	11
Madagascar	228,600	3,520,000	16
Total (including islands, &c.)	2,783,950	22,013,000	8
Portuguese Africa :			
Angola	603,000	3,600,000	6
Mozambique	293,000	1,500,000	5
Total (including islands, &c.)	979,824	5,518,000	6
Spanish Africa	246,757	444,000	2
German Africa :			
Cameroons	130,000	2,600,000	10
Southwest Africa	324,000	250,000	0.8
East Africa	381,000	1,760,000	5
Total (with Togoland)	831,000	5,110,000	6
Italian Africa	315,100	5,370,000	17
Congo State (Belgian)	827,000	15,000,000	18
Boer Republics	163,400	810, 00	5
Liberia	37,000	1,050,000	29
Turkish (Egypt and Tripoli)	836,000	7,980,000	10
Unappropriated	2,021,583	23,868,400	12
Great Lakes	80,350		
Total Africa	11,514,300	127,000,000	11

The unappropiated region in Africa includes Morocco (219,000 sq. miles, 6,000,000 inhabitants), and Bornu, Kanem, Wadai and Bagirmi, Mohammedan States in Central Soudan, possessing some degree of civilization, enough at least to make their subjection by any European power by no means an easy task. Their total area is about 323,000 sq. miles, and their combined population is estimated at nearly 10,000,000. Egyptian Soudan, which was under European domination until the revolt of the Mahdi and his followers in 1882, is also considered unappropriated territory. It includes all the region about the head waters of the Nile, with the Libyan desert to the west of the Nile valley.

In considering the values of the lands in the interior of Africa it should be remembered that knowledge of the interior is as yet too vague and imperfect to permit even an approximate estimate of their permanent value. At present actual European dominion, except in the temperate climate of South Africa, must be confined to the coastal lands or such parts of the interior as are readily accessible by means of the great river highways. That co-operation instead of competition should be the rule among the European powers in controlling their African possessions is Mr. WHITE's chief claim. These great river highways should be internationalized. Every encouragement should be extended to chartered commercial companies, which under the strict supervision of their own governments can carry on further explorations and develop the regions most valuable for civilized enterprise.

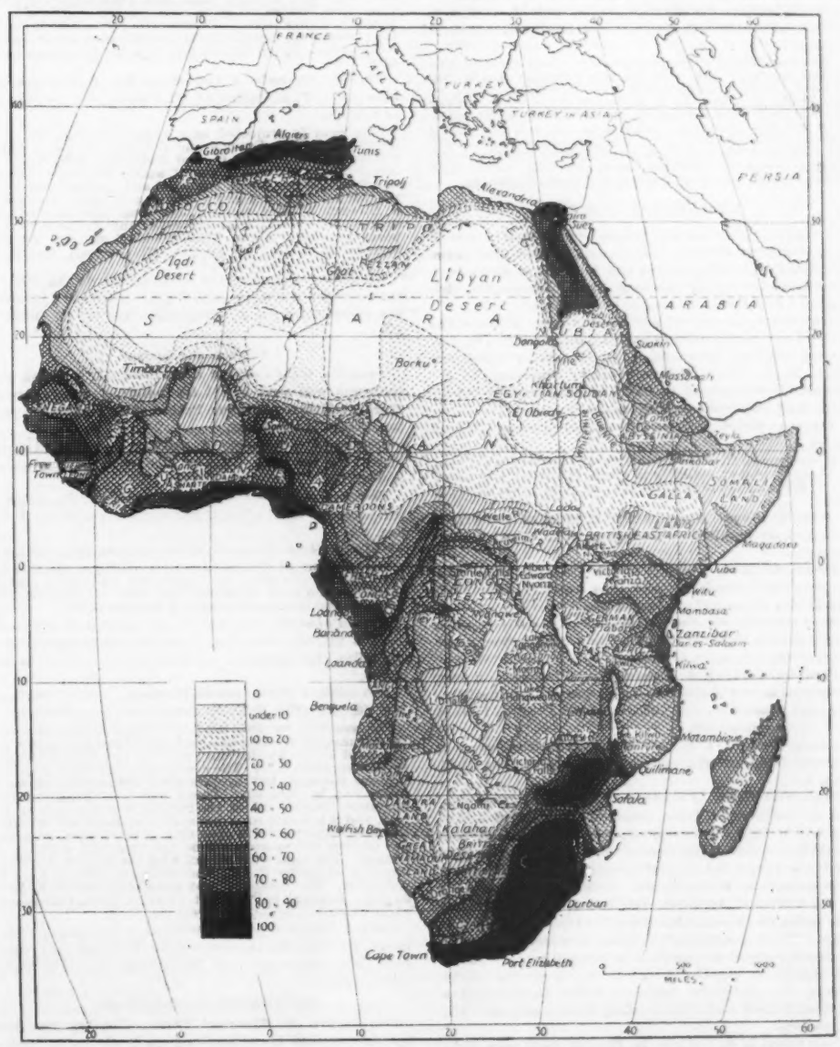


FIG. 2. THE COMPARATIVE VALUE OF AFRICAN LANDS FOR CIVILIZED DEVELOPMENT.

Areas of highest resistance to the European domination in white. Areas of highest value to the European powers in black.

The two most pressing needs, however, are that the European powers should co-operate in suppressing the slave trade and the traffic in intoxicating liquors. Of these two evils the latter is the worst, since it is more far-reaching in its effects and destroys the possibilities of commerce in other products, driving the natives into a sodden barbarism and rapidly destroying them.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Grayling, Twin Lakes & Northern.—The grading on this road from Grayling to Twin Lakes, Mich., 27.5 miles, will be completed in about two weeks. Seven miles of track have been laid.

Webb Mountain.—This short railway from Marlboro, Mass., to granite quarries owned by Geo. D. Webb, has been opened for traffic. The line is 7,500 ft. long, and has a maximum grade of 5%.

Bay of Quinte Ry. & Navigation Co.—This company has leased the Kingston, Napanee & Western Ry., and surveys are now being made for extensions from Tweed, Ont., north to the lumber and mining region, and from Harrowsmith, Ont., east to Sydenham, Ont., to tap the phosphate deposits in that section. M. J. Butler, of Deseronto, Ont., is Chief Engineer.

Portland & Rumford Falls.—About ½ of the grading has been completed on the extension to Rumford Falls, Me., 14 miles, and it is expected to have the remainder finished this month.

Pennsylvania.—An official of this company is reported as saying that work would probably begin on the extension of the Chestnut Hill Branch to the Trenton cut-off within one month. It is also announced that the cut-off itself will be opened for freight traffic between Glen Loch, Pa., and Morrisville, N. J., in about 30 days.

Little Falls & Dolgeville.—About 300 men are now at work on this New York line, and the force is being constantly increased. The grading is well advanced, being ready for the ties in some places. Contracts for the ties have been let, and they will soon be delivered.

Boston & Maine.—Work is stated to have been commenced at Middlesex Fells, Mass., on the line from that place to Stoneham.

Midland (Indiana).—Work on the branch from Sand Creek to Brazil, Ind., 20 miles, is being pushed by a large force of men and teams. The extension must be completed by Jan. 1, 1892, in order to obtain the subsidy voted in its aid.

New York, New Haven & Hartford.—This company is considering the construction of an extension from Williamsburg, Mass., to Shelburne Falls, a distance of 30 miles.

Projects and Surveys.

Blossburg Coal Co.—It is stated that this company will build a railway 6 miles long between Landrus and Arnot, Tioga Co., Pa.

Wheeling & Connellsville.—Frank J. Hearne, of Wheeling, W. Va., President, is reported as saying that this proposed road would certainly be built although work will not commence until next spring. The road will run from Wheeling, W. Va., to Connellsville, Pa., 73 miles, and will do principally a freight business. The organization of the company is fully complete.

Reading, Lancaster & Baltimore.—This company, whose incorporation was noted in our issue of Nov. 7, proposes to build a railway from Reading, Pa., to Perryville, Md., with a branch from Strasburg to Lancaster, Pa., a total distance of 52 miles. H. C. Lehman, Lancaster, Pa., President.

Sugar Run.—It is stated that work has commenced on this 9-mile railway in McKean Co., Pa., noted in our last issue. W. J. Lewis, Coudersport, Pa., President.

Southbridge, Sturbridge & Brookfield.—Arthur C. Moore, of Sturbridge, Mass., Chief Engineer, writes as follows:

The preliminary surveys have been made for this proposed railway, and location will probably begin this winter. It is projected to run from Brookfield, Mass., on the Boston & Albany R. R., to Southbridge, Mass., on the New York & New England R. R., a distance of 13 miles. The first 10 miles of the work will be sand and gravel, and the remainder broken rock. The grades and curves will be light, with the exception of the last two miles in Southbridge, where there will be curves varying from 3° to 7°. There will be two 100 ft. bridges and one 80 ft. bridge.

SOUTHERN.—Existing Roads.

Georgia, Carolina & Northern.—This road is now in operation from Monroe, N. C., to Jug Tavern, Ga., about 10 miles west of Athens, Ga., and 10 miles of track have been laid from Jug Tavern west toward Atlanta, Ga. This leaves a gap of only 25 miles to be completed.

Owensboro, Falls of Rough & Green River.—The new owners of this railway have organized with the following officers: President, M. O. Monarch; Vice-President, M. B. Mann, Belleville, Ind.; Secretary, S. M. Deane. It is intended to build an extension to Caneyville, Ky., during the coming season.

Darien Short Line.—The *Manufacturers' Record* says:

It is rumored that the Darien Short Line will pass into the control of its bondholders, who will extend the road. R. H. Walker, President, Darien, Ga., can give information.

Atlantic Coast Line.—About 12 miles of the extension from Greenville to Washington, N. C., 20 miles, have been graded.

Silver Springs, Ocala & Gulf.—Tracklaying on the Homosassee-Brooksville line has reached Inverness, Citrus Co., Fla., south of Homosassee.

Jacksonville, St. Augustine & Halifax River.—The 3-mile branch to San Mateo, Fla., has been graded, and tracklaying will begin at once.

Florida Central & Peninsula.—Grading is nearly completed on the 7-mile line from Starks, Bradford Co., Fla., to a connection with the Georgia Southern & Florida R. R. at Sampson City.

Louisville, St. Louis & Texas.—This company will probably build a 3-mile branch to coal fields near Skillman, Ky.

Tennessee River, Asheville & Coosa.—Andrew Johnson, of Chattanooga, Tenn., President, is reported as saying that by Dec. 1 between one and two thousand men would be at work on this line between Asheville, Ala., and the Coosa River, and that this section of the line would be completed by March 1, 1892. An effort is being made by the citizens of Anniston, Ala., to raise the bonus necessary to secure the extension from the Coosa River to that place. The company now has a line in operation from the Alabama Great Southern R. R. to Asheville.

Roanoke & Southern.—Cecil B. Smith, of Rocky Mount, Va., Assistant Engineer, writes to correct the statement made under this heading in our last issue. Mr. Smith says:

Contractors L. B. McCabe & Bro., of Baltimore, Md., with Manager E. P. H. Harrison and trestle builders, Messrs. Gaines & Mitten in charge, have just erected, in 35 working days, 960,000 F. B M. in seven trestles, situated 12¼ miles south of Rocky Mount, Va., with an average force of 40 men. This timber had been previously framed at Stoneville, N. C., and was shipped to the end of track and distributed by teams to the various trestles, which were grouped within 3 miles of one another. The somewhat largest of these trestles (called Giles Young) is 650 ft. long, 76 ft. high, built in 3 decks. For rapidity of erection and accuracy of designs and framing we feel that the above-named gentlemen and Mr. B. W. Butler, Resident Engineer, are entitled to all praise. The Mr. Grove referred to was, I believe, one of the foremen employed on the erection of the Giles Young trestle.

Tracklaying is in active progress on this division, and is within 7 or 8 miles of Rocky Mount, both north and south, and expected to meet by Dec. 10.

In addition to the above Chief Engineer Andrew Onderdonk, Winston, N. C., writes that 44 miles of track have been laid on the line from Martinsville to Roanoke, Va., 61.5 miles; 18 from Roanoke south and 26 miles from Martinsville north.

West Virginia Central & Pittsburg.—A press dispatch from Baltimore, Md., says:

The forthcoming annual report of this company will show largely increased traffic and earnings and extensive improvements to the main line and its branches during the year. The officials of the company say that the development of the mining and coking interests along the line during the year has exceeded expectations. The lumber trade is rapidly increasing, and many new mills have been started. In Tucker Co., W. Va., the Beaver Creek Lumber Co. and the Black Water Boom & Lumber Co. have established large mills, and are turning out 100,000 ft. of lumber a day. At Coketon there are already more than 100 ovens in operation, producing over 600 tons of coke a day. During the month the road has been constructed to Beverly, Randolph Co., W. Va., 7 miles south of Elkins. One mile south of Elkins the construction of a railroad northward has been begun, and will lead to Pittsburg. From Elkins to Bealington, Barbour Co., a distance of 18 miles, the West Virginia Central will build a road. At Bealington a narrow gage road is met, which runs to Grafton, a distance of 42 miles, which is owned by the Baltimore & Ohio road. This is to be made a standard-gage road as speedily as possible. From there the Baltimore & Ohio has a road to Morgantown, Monongahela Co. From there to Uniontown, Penn., there is a gap which the Baltimore & Ohio will fill, and this will furnish an entrance into Pittsburg. At Fairchance, a point on this gap, the Pennsylvania R. R. will be reached, thus affording another route into Pittsburg. No plans have been formed yet as to an extension southward, up Tygart's Valley toward Huntersville, Pocahontas Co., to the Chesapeake & Ohio R. R., but that such an extension will come in the not-distant future seems altogether probable.

Florida, Georgia & Carolinas Ry. & Transportation Co.—W. A. Gaines, of Mt. Carmel, S. C., writes us as follows:

This road is projected to run from Tampa, Fla., via Gainesville, Fla., Dupont and Washington, Ga., Abbeville and Greenville, S. C., and Hendersonville, N. C., to Asheville, N. C., a distance of about 600 miles. About one-fourth of the line is surveyed and graded, and work will probably be resumed about Jan. 1, 1892. The route is through a level country, affording light grades and curves. There will be no bridges of any size or other important works. About $1,250,000 local aid has already been raised, in addition to the right of way. Contracts will probably be let about Jan. 1, 1892.

Virginia.—Contracts are reported let for building a railway from Hot Springs to Warm Springs, Va., 5 miles. The contractors are: J. C. Carpenter and G. G. Gooch & Co.

Projects and Surveys.

Arcadia, Gulf Coast & Lakeland.—It is stated that contracts will soon be let for building this proposed Florida railway. Anthony Peters, of 88 Lincoln St., Boston, Mass., is President.

Sparks & Bayboro.—A railway is projected from Sparks to Bayboro, Ga., by Beckwith & Rogers, of Sparks, Ga.

New River Mineral Co.—It is stated that the company will probably build a line of railway to its mines at Ivanhoe, Va.

Gainesville & Sampson City.—A press dispatch says:

The citizens of Gainesville have called a meeting for Nov. 18 to devise ways and means for building a line of road from here to Sampson City, Fla., or some eligible point on the Georgia Southern & Florida R. R.

Moss Point & Pascagoula.—A project is on foot to build a railway from Moss Point to Pascagoula, Miss., 3½ miles. E. Castaner, of Moss Point, Miss., is interested.

Asheville & Weaverville Dummy.—Jas. R. Du Bois, Box 196, Asheville, N. C., Secretary, writes as follows:

The surveys for this road will begin as soon as a sufficient amount of stock has been subscribed to justify it. The road will be 8 miles long, and will run from Asheville to Weaverville, N. C. The route will be through a mountainous country, but by following the streams an easy grade can be secured. There will be no bridges of importance. Nearly all of the right of way has been promised, and it is hoped to secure sufficient local aid to build the line. The road will open up a good timber country, and lumber and tobacco will be the principal articles of freight. The road will connect with the lines of the Richmond & Danville R. R., and with the electric lines at Asheville. The company was chartered March 4, 1891. Jas. A. Reagan is President, and Col. Thad. Coleman is Chief Engineer; both of Weaverville, N. C.

Gulf & Chicago.—It is stated that P. Keating, of Pittsburgh, Pa., who has the contract for building this road from Cedar Point, Ala., to Tuscaloosa, Ga., will begin work at once.

NORTHWEST.—Existing Roads.

Burlington & Missouri River.—Construction has been begun upon an extension from Deadwood to Spearfish, S. Dak., about 16 miles. Kilpatrick Bros. have the contract.

Projects and Surveys.

Illinois.—A press dispatch from Danville, Ill., says:

There is a plan on foot to parallel the Chicago & Eastern Illinois Railroad between Chicago and Danville, also to extend the line south of Danville to the Toledo, St. Louis & Kansas City in order to form a St. Louis connection. The proposed route is to run a few miles west of Danville to the Mission coal fields of the Consolidated Coal Co. of St. Louis, thence north by way of Kankakee, into Chicago. Josephus Collett, the Terre Haute, Ind., millionaire, is reported to be interested in the new road.

Pueblo & Duluth.—A press dispatch from Neligh, Neb., the headquarters of this company, says:

President Hitchcock will be here to-morrow to begin the preparatory work on the Pueblo & Duluth. The drafting, specifications and contracts will be prepared and work let so that building may be begun as soon as the frost is out of the ground in the spring. The necessary means are on hand to build and equip 300 miles of the road from Sioux City, Ia. to Culbertson, Neb.

Quincy, Keokuk & Chicago.—The surveys for this railway from Quincy to Niota, Ill., 50 miles, are nearly completed.

La Salle & Bureau County.—Plans have been completed for this railway which is projected to connect the Illinois Central, the Chicago & Northwestern and the Chicago, Burlington & Quincy railways, at La Salle, Ind.

Marinette & Western.—Chartered in Wisconsin to build a railway from Marinette, Wis., west, via Antigo and Merrill to Abbottsford, Wis. The preliminary surveys will begin at once. Among the incorporators are J. F. Hancock, A. C. Merryman, and others, of Marinette, Wis.

SOUTHWEST.—Existing Roads.

Missouri Midland.—According to reports the subscriptions to the capital stock of this new corporation come in slowly. This is an attempt to reorganize the old Cleveland, St. Louis & Kansas City Ry. Co. and extend its line to Alton, below St. Charles, and to the Warren County line above St. Charles, Mo. All of the local banks are to be made agents of the projectors of the scheme, and are to be given a per cent. and the use of the money paid in until the requisite amount has been raised. The banks are also expected to subscribe $10,000 apiece to the capital stock. The distance from Alton to the other end of the line is about 70 miles, about 16 miles of which are already constructed.

Projects and Surveys.

Pan American.—Wm. H. Baker, of Victoria, Tex., Chief Engineer, writes us that this road is projected to run from Victoria, Tex., via Refugio, Neuces, Anthony and Kingston, to Brownsville, Tex., a distance of 240 miles. The line has been located from Anthony to Brownsville, Tex., and the preliminary surveys have just been begun from Victoria, Tex., south. The work will vary from 6,000 cu. yds. to 10,000 cu. yds. per mile; maximum grade, 1%, and maximum curve, 5°.

Montagu Coal Mining Co.—This company propose s to build 3 miles of railway near Fort Worth, Tex.

South Galveston & Gulf Shore.—The City Councils of Galveston, Tex., have granted franchises to this company for its proposed railway from Galveston to South Galveston, Tex., 20 miles. M. F. Mott, of Galveston, Tex. is President.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—A press dispatch from Kalispell, Mont., says:

The latest information received here regarding the Pacific extension of the Great Northern railway is that the track layers have reached a point about 55 miles east of Kalispell, and are coming this way at the rate of a little over a mile a day. The grading is all done, with the exception of a few unfinished spots, which the contractors claim will be out of the way before the track reaches them. The bridge across the north fork of the Flathead River, 24 miles east of here, is being rapidly pushed to completion, and will be done in time to prevent delay of tracklaying. It is safe to say that the rails will reach Kalispell by Dec. 15. The only thing to fear is that winter weather may set in before that time. But this is not probable, as the winter rarely begins in this valley before Christmas.

Southern Pacific.—The proposed branch to Redlands, Cal., will connect with the main line at Nehant Siding, near Mound City. Work has been commenced and it is expected to have the line completed in two months

San Joaquin Valley.—The first section of this road from Fresno to Pullasky, Cal., 25 miles, will be opened for traffic on Nov. 25.

Los Angeles Terminal.—This company's line between Los Angeles and Long Beach, Cal., has been opened for traffic.

Denver, Apex & Western.—Preparations are being made to begin work on the first 63 miles of this road from Denver to Georgetown, Colo. Several bids have been received for the work and contracts will probably be let soon.

Rio Grande Western.—Various reports are in circulation in regard to a proposed extension of this road to San Francisco. According to recent dispatches from Denver Colo., General Manager D. C. Dodge is reported as saying that the line would ultimately be extended to the Pacific Coast and that surveys had been made to the Sierra Nevada Mountains. The length of such an extension would be about 832 miles. There is little prospect, however, of the line being built for some years, if ever.

Projects and Surveys.

Corvallis, Brownsville & Eastern.—A correspondent writes that this company has never made a survey for its proposed line and that its charter will probably lapse for want of organization.

Portland & Fairview.—A company by this name has been chartered in Oregon to build a railway from Portland to Fairview. Jas. D. Hart, Portland, Ore., President.

CITY TRANSIT.

Electric Railways.—***Brooklyn, N. Y.***—The Coney Island & Brooklyn Ry. Co. has been given permission to convert its road to a single trolley overhead electric system.

Bellefonte, Pa.—The Bellefonte Electric Street Ry. Co. has been incorporated by L. A. Schafer, W. F. Reeder and J. M. Potter; $18,000.

Baltimore, Md.—The South Baltimore & Curtis Bay Ry. Co. will begin work soon on an electric road 3¼ miles

long. For particulars address W. S. Rayner. The Union Passenger Ry. Co. has applied for permission to adopt electric traction.

Raleigh Springs, Tenn.—The Raleigh Springs Ry. Co. will build an electric road 11 miles long to Memphis, and tracklaying will be commenced in December. Cooper & Bordman have the contract for ties and timber, the Thomson-Houston Electric Co. for electrical equipment, and the Illinois Steel Co. for rails. Contracts are to be let shortly for power plant, piling, poles, cars, iron bridge 130 ft. span, paving, corrugated iron, brick and iron trusses. President, Daniel O'Connor; General Manager, W. R. Hall; Chief Engineer, E. T. Lynch.

Jacksonville, Fla.—An ordinance has been passed, permitting the Jacksonville Street Ry. Co. to adopt electric traction.

Kansas City, Mo.—The Interstate Consolidated Rapid Transit Ry. Co. has applied for permission to substitute an overhead electric system for its cable line on Eighth St.

Colfax, Col.—An electric storage battery road from Colfax to Barnum is proposed by F. A. Arbuckle, L. L. Gray and M. S. Noah.

Galveston, Tex.—A franchise has been granted to the South Galveston & Gulf Shore Electric Ry. Co., for a line 13 miles long. President, Geo. J. Gray, of Denver, Col.

Dummy Railway.—*Chicago, Ill.*—Mr. C. T. Yerkes, President of the North Side Street Ry. Co., has imported a steam dummy engine from England, of a type said to be very successfully operated there, and superior to horse and cable power for suburban roads.

Horse Railways.—Velasco, Tex.; Velasco Street Ry. Co.; 3 miles. Princeton, Ill.; Princeton City Street Ry Co.; M. C. Clark, M. T. W. Lathrop, F. W. Clark; $20,000.

Companies.—International Electric Railway Co., of Chicago, Ill.; J. T. Hanna, M. M. Wood and D. L. Coe; $2,500,000. United States Rapid Transit Co., of Chicago, Ill.; $5,000,000.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Groton, N. Y.*—The Groton Bridge & Mf'g Co., of Groton, N. Y., has the contract for a bridge at Caribou, Me., consisting of 3 spans each 150 ft. with 18 ft. roadway. Also for 2 spans 81 ft. each and 16-ft. roadway at Wytopitlock, between Penobscot and Aroostook counties, Me. Both of these bridges will have cylinder pier foundations. Shop work will soon be commenced on 4 spans, 76, 82, 108 and 126 ft., including 2 draw spans for Brazoria Co., Tex. Also a 228 ft. span for Shenandoah Co., Va. Large bridges at Newaygo, Mich., four 110-ft. spans, and Marble Falls, Tex., one 270 ft., two 150 ft. and one 110 ft. spans are in process of erection. This company has also a large number of smaller spans under contract.

Wyoming Co., N. Y.—An iron bridge will be built at Whipple's Corners to replace the present wooden structure.

Camden, N. J.—The Board of Freeholders has decided to build an $18,000 draw bridge over Cooper's Creek.

Cincinnati, O.—In Cincinnati the Cincinnati & Covington Rapid Transit Bridge Co., organized under the laws of Ohio, and the Covington & Cincinnati Rapid Transit Bridge Co., organized under the laws of Kentucky, have been consolidated under the name of the former company. Col. John McLeod, of Louisville, Ky., has been elected Consulting Engineer of the consolidated company. It is the purpose of the new organization to construct a four-track railway bridge, adapted to rapid transit between the cities of Cincinnati and Covington.

Wheeling, W. Va.—A survey for a bridge from the lower end of Wheeling to the north end of Bellaire has been made. Plans will be made and an estimate of the cost.

Newport, Ky.—The King Iron Bridge & Mfg. Co., of Cleveland, O., which built the big rapid transit cantilever bridge between this city and Cincinnati, has received the contract for erecting a similar structure across the Licking River, between this city and Covington, from the foot of Eleventh St. The work of construction will not commence until next spring.

HIGHWAYS.

Pennsylvania.—The contract for Telford paving and Darby turnpike has been awarded to B. M. & J. F. Shanley at about $15,000. The road will be about 6 miles in length and will have a width of 18 ft. Mr. George C. Hetzel, of Chester, is President of the Darby & Chester Telford Road Co., which has a capital stock of $75,000.

Illinois.—The Commissioners of Richwood township have laid out an east and west road from Old Mount Holly to New Mount Holly.

Missouri.—The Kings Highway Boulevard Syndicate, of St. Louis, has been incorporated by W. P. Croswhite, George W. Wilson and W. N. Terry. The County Court, at St. Charles, has ordered the County Surveyor to survey two new roads.

WATER-WORKS.

NEW ENGLAND.

Jericho Centre, Vt.—It is reported that mains are being laid.

St. Johnsbury, Vt.—A new supply for the village works is projected, and will probably be discussed at a village meeting in January. The purchase of the plant of the St. Johnsbury Aqueduct Co. is spoken of.

Fitchburg, Mass.—Surveys of various possible sources for an additional supply are to be made, with City Engineer Lovell in charge, and C. A. Allen, Worcester, Consulting Engineer.

Lowell, Mass.—The driven well experiments will be continued, with the hope that an increased supply may be obtained.

Medford, Mass.—Mains will be laid in Hall Park at a cost of about $2,500.

Pittsfield, Mass.—The location of the pumping station mentioned last week, is to be changed, according to report, so that water will be pumped from the overflow of Sackett Brook reservoir. A basin will be excavated. The appropriation has been increased from $3,000 to $6,000. M. M. Tidd, Boston, has reported upon a permanent increase to the supply.

East Providence, R. I.—Arrangements are being made to supply Riverside and other parts of the town outside of the Watchemoket Fire District with water from the Pawtucket works, which now supply parts of the town.

Essex, Conn.—Works are projected. Address G. H. Hardman.

Hartford, Conn.—A new reservoir is projected.

South Norwalk, Conn.—Explorations for a new reservoir site are being made.

MIDDLE.

Clifton Springs, N. Y.—A second committee has been appointed to investigate works. W. W. Miner and T. B. Titus are members.

East Syracuse, N. Y.—Engineer O. Bogardus has completed preliminary surveys for works with a supply from White Lake. The lake is 4.83 miles from and 149 ft. above the village. A reservoir site has been located. An 8-in. main is proposed to the reservoir and a 12-in. main from the reservoir to the village. It is estimated that the works with about 3½ miles of distributing mains would cost $37,500.

Gloversville, N. Y.—There is talk of an additional supply.

Glens Falls, N. Y.—The Trustees have voted to rent or buy a new pump and boilers.

Liberty, N. Y.—The citizens have requested the Village Trustees to submit to the vote of the people a proposition to issue $20,000 of bonds for works. A. Grant Childs has reported in favor of a supply from a reservoir on a brook rising in Young's Gap, the site to be about 170 ft. above and 1½ miles from the village. Estimated cost, $19,215.

New York, N. Y.—The Commissioner of Public Works has transmitted to the Aqueduct Commissioners final plans and maps showing lands required for the construction of a high masonry dam for a reservoir between Quaker Bridge and the Croton dam, to be known as Cornell's dam. The Commissioners have requested the Corporation Council to take steps to acquire the necessary land for the dam and reservoir.

Schoharie, N. Y.—The company has begun the construction of a storage reservoir.

Ticonderoga, N. Y.—S. E. Babcock, Little Falls, has reported on village works with a gravity supply from a reservoir on Chillson Hill Brook, some two or three miles distant. Estimated cost, $40,000 to $50,000. Small works are operated by a company.

Orange, N. J.—The Water Committee has recommended the issuance of $10,000 of 5% bonds to pay for cleaning the reservoir.

Ashbourne and Ogonts, Pa.—The citizens are agitating an extension of the Jenkintown works.

Greensburg, Pa.—A second company is talked of, owing to alleged inadequate supply.

Montoursville, Pa.—A vote on works was to be taken Nov. 17.

Morton and Rutledge, Pa.—There is talk of organizing a company to supply both places.

Royer's Ford, Pa.—The company will increase its stock from $40,000 to $60,000.

Tunkhannock, Pa.—It is reported that improvements will be made.

Elkton, Md.—The Maryland Water Co. of Cecil Co. has been or will soon be incorporated by G. M. Johnson, Baltimore; W. T. Warburton, of Elkton, and others. It is stated that Mr. Johnson will contract to build the works, and that construction will be started before spring.

Lonaconing, Md.—B. L. Somerville, R. M. Boyd and others propose to incorporate a company soon, to be known as the Lonaconing Water Co. The capital stock will be $25,000.

SOUTHERN.

Norfolk, Va.—Bonds to the amount of $25,000 have been authorized for extending the mains.

Weston, W. Va.—It is stated that the people still want works.

Bryson City, N. C.—Address H. L. Leatherwood regarding proposed water and electric lighting plants.

New Berne, N. C.—Bids for works were secured Nov. 16 by W. Ellis, Chairman.

DeLand, Fla.—It is reported that a franchise has been granted to J. B. Clough and others.

Monroe, La.—The Lee Improvement Co., St. Louis, Mo., will, it is reported, put in water and electric lighting plants.

Lake Charles, La.—Works are still projected.

Cleveland, Ky.—Guild & White, Chattanooga, are the parties who have made a proposition to build works.

Russellville, Ky.—A company has recently been formed to supply water by pumping from the "big spring." A stand-pipe may be used. B. B. Andrews is Mayor.

NORTH CENTRAL.

Norwood, O.—Works are being discussed.

Brightwood, Ind.—A committee has been appointed to confer with the Indianapolis Water Co. regarding a supply.

Franklin, Ind.—The plant of the Franklin Water, Light & Power Co. has been tested and accepted. J. J. Hainsworth, Chicago, is Vice-President and was Constructing Engineer. M. L. Johnson is Secretary. The Boughen Engineering Co., Cincinnati, furnished the machinery. The lighting plant is the Thomson-Houston system.

North Vernon, Ind.—Works with four miles of mains, estimated to cost $24,000, have been voted.

Mancelona, Mich.—It is stated that the Walker system will be adopted.

South Haven, Mich.—The supply will be from Lake Michigan.

Atlanta, Ill.—J. J. Downey, J. B. Lambert, and others have been appointed a water committee on proposed works. The supply will probably be from wells.

Belleville and East St. Louis, Ill.—The proposed city works may obtain a supply from the East St. Louis plant, which, it is said, is to be enlarged by the erection of two reservoirs.

Metropolis, Ill.—G. C. Morgan, Chicago, has received a contract for a water and electric lighting plant to be completed by July 1, 1892. Contract price, $50,925.

Mount Vernon, Ill.—Works are to be built by a company, it is said.

O'Fallon, Ill.—A committee has been appointed to arrange for the immediate construction of works.

Spring Valley, Ill.—Works are proposed and an artesian well has been ordered sunk.

Willmette, Ill.—The Town Board has approved the plans of John A. Cole, Chicago, for water and sewerage systems. It is said that the supply will be from the Evanston works.

NORTHWESTERN.

Boone, Ia.—Construction of a 2,000,000-gall. reservoir has just been started.

De Witt, Ia.—A contract for works has been let.

Excelsior, Minn.—A report on works has been presented and it is said that bids will soon be requested.

Detroit, Minn.—City Engineer E. H. Keating has estimated the cost of duplicating the company's water and gas plants at $1,064,000, nearly $500,000 less than the estimates of C. B. Davis, recently referred to in this journal.

Beatrice, Neb.—The Council has decided to buy a Smedley pump for the new plant.

Chamberlain, S. Dak.—It is reported that the city works have been leased by C. J. Bunting, for some time connected with them.

Deadwood, S. Dak.—The mains will be extended.

SOUTHWESTERN.

Kansas City, Mo.—The Council has ordered issued the $2,000,000 of bonds voted some time since for works.

Monticello, Ark.—Preparations to build works are said to be in progress.

Pine Bluff, Ark.—It is reported that $25,000 will be expended for new pumping machinery and extensions. Address C. B. Wilkinson, Receiver.

Belcherville, Tex.—Works are said to be needed, and an artesian well and stand-pipe are spoken of.

Elgin, Tex.—Press dispatches state that a contract for works has been awarded to Kelly & Copeland.

Orange, Tex.—It is reported that O. J. Gorman, Dallas, has organized a company to build works here at a cost of about $50,000, construction to start very soon.

Waco, Tex.—The College Heights Artesian Water Co. has been incorporated; capital stock, $10,000.

Santa Fe, N. M.—A franchise for a second plant has been granted to the Santa Fe Irrigation Co. Works must be completed within one year from the acceptance of the franchise. The supply must be by gravity, filtered, with a pressure of at least 80 lbs. Forty hydrants at a yearly rental of $70 each will be taken by the city.

PACIFIC.

Aberdeen, Wash.—The *Herald* is urging the town to own the works.

Ballard, Wash.—The Northwestern Oil, Gas, Artesian Test Wells and Water-Works Construction Co. has applied for a franchise. The application was referred to a committee.

La Grande, Ore.—Additional bonds to the amount of $20,000 have been voted for the proposed city plant. The sum of $50,000 is now available.

Oakesdale, Wash.—Works are proposed.

Pendleton, Ore.—The McKay Creek Irrigation Co. has offered to furnish water to the city.

Long Beach, Cal.—The works will be improved at a cost of $10,000.

Vallejo, Cal.—A city investigating committee has re-

ported that the company ought to make certain improvements to the works, and that if these are not made the committee recommends that the city build works

Santa Paula, Cal.—The Santa Paula Water-Works Co. has been incorporated to build works, generate electricity, &c.; capital stock, $150,000.

ARTESIAN WELLS.

Lowell, Mass.—More experimental wells will be sunk. City Engineer Bowers will be in charge.

Woodstown, N. J.—The authorities are re-advertising for bids for sinking a well.

Eastman, Ga.—The sum of $1,160 has been raised toward sinking a well.

Appalachicola, Fla.—Agitation for a well continues.

Forbes, S. Dak.—Irrigation Engineer Baldwin has located sites for 6 wells in the township.

Celeste, Tex.—A well is talked of.

Pomeroy, Wash.—The sinking of a well will soon be started.

Caldwell, Ida.—A well is being sunk. If successful it is said that several others will be put down.

IRRIGATION.

Monument, Colo.—Bids are wanted until Dec. 1 by State Engineer J. P. Maxwell, Denver, Colo., for building a reservoir near the head of Monument Creek and near the town of Monument. The amount available is $28,000.

Ellensburg, Wash.—The Middle Kittitas Irrigation District has voted to issue bonds.

Delano, Cal.—Surveys for the Poso Irrigation District are said to be completed. The Board is correspondi ng with contractors.

Redlands, Cal.—Arrangements are being made between the Bear Valley Irrigation Co., Lugonia Water Co. and H. S. Williams for the irrigation of 1,800 acres.

San Diego, Cal.—The Linda Vista Irrigation District will vote on the issuance of $1,000,000 of bonds. There are 42,000 acres in the district.

San Jacinto, Cal.—Surveys and estimates will be made for the San Jacinto & Pleasant Valley Irrigation District.

San Marcos, Cal.—The people will petition for the formation of a district.

New Companies.—Belle Fourche, Vale & Empire Improvement Co., Vale, S. Dak.; $100,000; to irrigate, 10,000 acres, through a ditch 16 ft. wide. East Fork Irrigating Canal Co., Mount Hood, Ore.; $7,000; S. M. Baldwin and others. Lone Rock Irrigation Co., Pendleton, Ore. $250,000; C. B. Wade, I. G. Hailey and others. Alpine Springs Land & Water Co., Los Angeles, Cal.; $50,000; directors, Nathan Cole, Jr., W. H. Griffin and others. Long Valley Land & Irrigation Co., Oakland, Cal.; $300,000, of which $160,000 has been subscribed; Edwin Ferris, Frank G. Ward and others.

SEWERAGE AND MUNICIPAL.

Sewers.—*Massachusetts.*—Revere. The Sewerage Committee has presented for the approval of the State Board of Health a plan for a system of sewerage to discharge into the metropolitan sewerage system of Boston.

New York.—Port Chester. The question of sewerage is under consideration.—Brooklyn. The lowest bidder for a section of the sewerage system of Ward 26 was D. J. Creem, $66,958.

New Jersey.—South Orange has adopted a resolution to the effect that no sewerage system for the village which would cost more than $100,000 will be considered financially practicable. The resolution was passed especially for the guidance of the Board of Engineers, who have been appointed to prepare plans and specifications for a sewerage system for the village.—Orange.—The Common Council will probably enter into a contract with the townships of Bloomfield and Montclair for the construction and use of a joint trunk outlet sewer to the Passaic River at Belleville, where a tidal basin is to be built and the sewerage discharged twice in 24 hours.—Montclair. The Township Committee has adopted the draft agreement with Orange, and Engineers Bassett and Owen have been ordered to draw up plans and estimates of the work.

Pennsylvania.—Wilkinsburg.—Edeboner & Cooper, borough engineers, are preparing plans for 24-in. main sewers to the Monongahela River; estimated cost, $25,000.

Maryland.—Hagerstown. A New York company has made a proposition to the mayor and council to construct a system of sewerage. The town is to grant the franchise free, and the company is to get paid by the owners of private houses which run sewage into the pipes.

Ohio.—Findlay. The city engineer has adopted plans for the sewerage of the south side. The main sewer will be 6 ft. diameter.

Michigan.—Owosso. A franchise for a sewerage system has been applied for.

Illinois.—Joliet. A New York company has made a proposition to build sewers on the franchise plan.—Waukegan. A sewerage system is to be built for the central part of the city at a cost of $28,000.

Minnesota.—Owatonna. Plans and specifications for a system of sewerage are to be prepared by Mr. Loweth, of St. Paul.

Missouri.—Carthage. The question of granting a sewerage franchise to the Lewis-Mercer Construction Co., of New York, is under consideration.

Oregon.—Portland. D. W. Taylor, Superintendent of Streets, has prepared plans for 12-in. terra cotta pipe sewers for the east side.

Washington.—North Yakima. The contract for the sewerage system has been awarded to R. Schmidt, of Seattle, at $41,000, and work has been commenced.—Tacoma. The Board of Public Works has prepared plans for a main storm water relief sewer to cost $25,000. It is estimated for a rainfall of 1 in. per hour over the drainage area.

There will be about 4,000 ft. of roadway, 35 ft. wide; 700 ft., 27 ft. wide, and 1,000 ft., 20 ft wide; also 7,500 ft. of walks, 15 ft. wide, and 1,700 ft., 5 ft. wide. The telford macadam will be of 2-in. stone, laid 12 ins. thick for the roadways, and 8 ins. thick for the walks. The former will be on a foundation of quarry stone, 7 to 9 ins. deep, 3 to 6 ins. wide and 8 to 18 ins. long. There will be 150 days' work each for double watering cart, double horse 2½ ton sectional roller, and 15-ton steam roller. The contract has been awarded to H. P. Nawn, of Boston.

	J. Killilan.	H. P. Nawn.	F. Maley.	W. B. Munroe.	Kelley & O'Hearn.	Jones & Meehan.	J. Driscoll & Sons.	N. E. Paving Co.
3,000 cu. yds. of macadam for 8-in walks.	$1.96	$3.00	$2.27	$2.30	$2.23	$2.65	$3.00	$1.75
7,000 cu. yds. of Telford macadam for 12-in. roads	1.96	2.10	2.27	2.30	2.17	2.50	4.50	4.91
150 days double watering cart	4.00	5.00	5.00	5.00	7.50	6.00	6.00	5.00
150 days sectional roller	4.00	5.00	6.00	6.00	7.50	5.25	6.00	5.00
150 days steam roller	10.00	10.00	15.00	14.00	20.00	15.00	18.00	12.50
200 cu. yds. stone on ground	1.00	1.75	.....	.....	0.50	1.00	0.50	0.50
Totals	$22,100	$26,350	$26,600	$26,750	$29,130	$29,187	$44,900	$51,965

Arizona.—Phœnix. Mr. J. B. Alexander, Secretary of the Arizona Water-Works & Sewerage Co., which has a franchise from the city, states that the company proposes to commence work at once on the first 5 miles of the system, and to have that part finished by March, 1892. This will require 8,800 ft. of 16-in. vitrified pipe, 2,050 ft. of 12-in., 3,180 ft. of 8-in., 19,780 ft. of 6-in., 700 ft. of 16-in. iron pipe, 696 Ys., 73 perforated manhole covers and frames, and 14 automatic flush tanks of 400 galls. capacity each. The estimated cost of material and construction is $60,000, and $40,000 additional for the rest, or $100,000 in all.

Ontario.—Deseronto. The Town Council has appointed Mr. M. J. Butler, Am. Soc. C. E., to examine into and design a system of sewerage. It is not intended to build the whole system at once, but to carry it on as the funds permit.

Streets.—*Massachusetts.*—Malden. Irvington St. is to be widened to 60 ft.

Rhode Island.—Pawtucket. It is stated that the vitrified brick pavement on Broadway is very slippery in cold and snowy weather owing to the smoothness of the surface.

Maryland.—Hagerstown. The city council will hold a special meeting to consider the question of laying asphalt paving on the principal streets.

Pennsylvania.—Devon Station. Smith & Son, Norristown, have a contract for 1½ miles of patent paving.—Philadelphia. The Vulcanite Paving Co. has a contract for asphalt paving on North Broad St. To test the merits of the material, one block will be laid with rock asphalt and the remainder with Trinidad asphalt.

Florida.—Jacksonville. The Board of Trade has been discussing various paving materials and is apparently inclined to favor asphalt.

Illinois.—Chicago. The mayor has submitted to the council a recommendation for the improvement of several streets by granite and cedar block pavement.

Colorado.—Denver. The Denver Gilsonite Paving Co has been incorporated to lay Colorado asphalt paving. C. O. Baxter and J. B. Hinchman; $25,000.

Bonds.—Los Gatos, Cal.; $20.000 for sewers; $3,000 for city hall. Malden, Mass., $100,000 for public parks; Jamestown, N. Y.; $10,000 for sewers. Waltham, Mass., $100,000 for sewers, at 4½%.

ELECTRICAL.

Electric Light.—*Manchester, N. H.*—A contract for street lighting for three years has been awarded to the Manchester Electric Light Co. at 37½ and 34½ cts. per light per night for arm and pole lights.

Quakertown, Pa.—A vote on the electric lighting question will be taken Dec. 29.

Cincinnati, O.—The Board of Lighting is having specifications prepared for electric lighting.

Quincy, Ill.—A contract for electric lighting for 3 years has been awarded to the electric light company at $75 per light per annum, instead of $90 as under the old contract.

Milwaukee, Wis.—The City Council is investigating the electric light question, and a committee recently visited Chicago to examine the plant and obtain information.

Companies.—Storage Battery Co., of Sioux City, Ia.; E. M. Dunbar, J. F. Peavey and C. S. Wallis; $1,000,000. Bronx Electric Light Co., of New York and Westchester, N. Y.; John I. Munn, C. S. Leary and John S. Brush, New York; $15,000. Gardner Electric Light Co., of Gardner, Mass.; President, R. L. Bent; $30,000. Wolverton Arc Electric Light Co., of Newark, N. J.; J. E. Wolverton, W. McCubben and J. L. Cox, of New York, N. Y.; $250,000. Franklin-Morse Electrical & Mfg. Co., of East St. Louis, Ill.; Wm. Koedding, F. D. Durgin and W. H. Jones; $5,000,000.

CONTRACTING.

Macadamizing.—*Brookline, Mass.*—The following proposals for macadamizing roads and walks were received Nov. 12 by Mr. A. H. French, Town Engineer.

New Croton Aqueduct.—*New York, N. Y.*—The Aqueduct Commissioners have awarded a contract for fencing and improving the grounds around several of the shafts to Levy & Quinn at $33,437.

Street Work.—*Salt Lake City, Utah.*—The Board of Public Works has awarded a $93,000 contract for paving State St. to the Pacific Paving Co., of Salt Lake City: 5-in. sandstone curbing, $1.05 per lin. ft.; granite block and sandstone paving, $2.52 per sq. yd.; bituminous rock asphalt paving, $3.25 per sq. yd.

Sewer Materials.—*Baltimore, Md.*—The following contracts have been awarded for materials for the Eagle St., Fulton Ave. and Monroe St. sewer: Hanover Portland cement, Charles C. McColgan & Co., $2.70 per bbl.; Round Top cement, John Bullock & Sons, $1.18 per bbl. in bags; Cumberland cement, S. M. Hamilton, $1.18 per bbl. in bags; building stone, David Leonard, $2 per cu. yd.; bricks, hand-made, Frederic Rice, $9 per 1,000; bricks, machine made, Pitcher & Creager, $8.50 per 1,000; sand, Mrs. Wilhelmena Duvel, 85 cts. per cu. yd.; sewer blocks, Guilford & Walterville Granite Co., $126 per 1,000, or $2.82 per sq. yd. Contracts have also been awarded for materials for Wolfe St. sewer as follows: Cumberland cement, in bags, S. M. Hamilton & Co., $1.18 per bbl; Hanover Portland cement, C. C. McColgan & Co., $.75 per bbl.; sand, P. Keelty, 84 cts. per cu. yd.; stone, Maryland Stone Co., $1.75 per cu. yd.; hand made bricks, Daniel Donnelly & Son, $2.79 per 1,000.

PROPOSALS OPEN.

Dredging.—*Boston, Mass.*—Dredging in the main ship channel of Boston harbor. Lieut. Col. S. M. Mansfield, U. S. Engineer Office. Dec. 10.

Sewer Material.—*Providence, R. I.*—Pipe 12 and 15 ins. diam.; 1,500,000 brick. R. E. Smith, Commissioner of Public Works. Nov. 23.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have built some compound tank engines for the Kings County Elevated Road, Brooklyn, N. Y. They have an order for a compound express passenger engine for the Philadelphia & Reading, and for 1 compound passenger and 1 compound freight engine for the New Jersey Central.

Cars.—The Louisville, New Albany & Chicago will spend a large amount on new rolling stock. The Barney & Smith Mfg. Co., of Dayton, O., has built 3 sleeping cars for the Great Northern. The Ohio Falls Car Co., of Jeffersonville, Ind., has built 1,000 box cars for the Pennsylvania. The Pullman Palace Car Co., of Chicago, Ill., will build 5 ordinary and 3 parlor cars for the Columbus, Hocking Valley & Toledo R. R. The Souder Railway Freight Car Co., of Newport, Ky., has been incorporated to manufacture cars on the patents of Jacob J. Souder; $2,000,000.

Petroleum Engine.—Priestman & Co., of Philadelphia, Pa., write us that they have undertaken the manufacture of the Priestman petroleum engine, and are now exhibiting one of their make at the American Institute Fair New York. The consumption of kerosene oil is said to be less than 1 pint per HP. per hour. The engine was described and illustrated in our issue of Nov. 17, 1888, and is in extensive use abroad. It was awarded a gold medal at the Edinburgh International Exhibition 1890. Estimating the cost of oil at 10 cts. per gall., although in Philadelphia the price is only about 5½ cts., with allowance for barrels, the engine is said to cost less than 1½ cts. per HP. per hour, being a very economical showing.

Companies.—Builders' Supply Co., of Chicago, Ill. Michael McInerny, J. C. Donnelly and John F. Kenny; $25,000. Belleville Paving Brick & Tile Co., of Belleville: Ill.: A. Gooding, C. A. Stookey and W. Eyman; $30,000. Mount Vernon Brick and Paving Co., of Mount Vernon, Ill.: George W. Evans, T. L. Watson and S. T. Stratton, $25,000. Hill Double Lock Safety Switch Co., of Chicago; Ill.: John J. Hill, W. H. M. Hill and D. H. Curtis; $250,000. Denver Gilsanite Paving Co., of Denver, Col.: C. O. Baxter and R. Lee Hinchman; $25,000.